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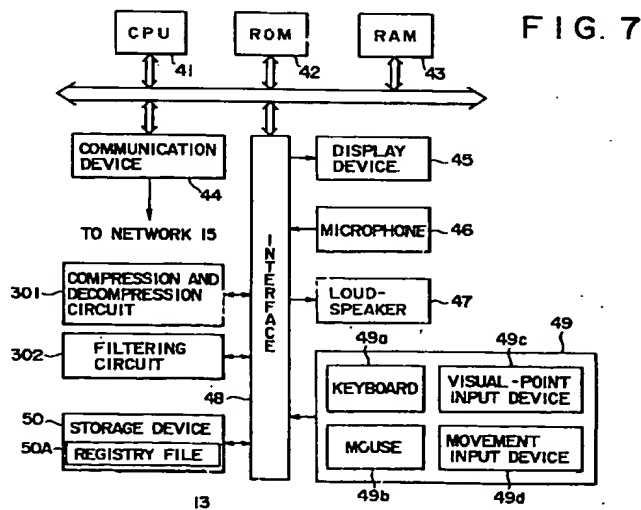
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(54) An information processing apparatus, an information processing method, and a medium for use in a three-dimensional virtual reality space sharing system

(57) An information processing apparatus, an information processing method, and a medium that allow the user to have more varied voice chats unique to a three-dimensional virtual reality space than before. The user clicks one of voice tone select radio buttons (49) to select a normal voice, a tone-changed voice, a robot voice, or an intonation-inverted voice. In addition, by

operating a voice tone adjusting slider, the user finely adjusts a selected voice tone parameter. A voice signal inputted (46) by the user is filtered (302) with the preset voice tone parameter before being transmitted (48) to another user.



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## Description

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

The present invention generally relates to an information processing apparatus, an information processing method, and a medium for use in a three-dimensional virtual reality space sharing system and, more particularly, to an information processing apparatus, an information processing method, and a medium for use in a three-dimensional virtual reality space sharing system, which are capable of performing more varied voice chats than before by converting a voice tone of a particular user into a desired voice tone in a three-dimensional virtual reality space shared by a plurality of users.

#### 2. Description of Related Art

A cyberspace service named Habitat (trademark) is known in the so-called personal computer communications services such as NIFTY-Serve (trademark) of Japan and CompuServe (trademark) of US in which a plurality of users connect their personal computers via modems and public telephone network to the host computers installed at the centers of the services to access them in predetermined protocols. Development of Habitat started in 1985 by Lucas Film of the US, operated by Quantum Link, one of US commercial networks, for about three years. Then, Habitat started its service in NIFTY-Serve as Fujitsu Habitat (trademark) in February 1990. In Habitat, users can send their alter egos called avatars (the incarnation of a god figuring in the Hindu mythology) into a virtual city called Populopolis drawn by two-dimensional graphics to have a chat (namely, a realtime conversation based on text entered and displayed) with each other. For further details of Habitat, refer to the Japanese translation of "Cyberspace: First Steps," Michael Benedikt, ed., 1991, MIT Press Cambridge, MA, ISBN0-262-02327-X, pp. 273 through 301, the translation being published March 20, 1994, by NTT Publishing, ISBN4-87188-265-9C0010, pp. 282-307.

Thus, when an avatar of a user meets an avatar of another user in a virtual reality space, the user can chat with the avatar of another user. However, this chat is ordinarily performed on a text basis, making it difficult for users unskilled with keyboard operation to enjoy chat with ease.

To overcome this problem, a method of performing voice chat by use of a voice signal rather than text is disclosed in Japanese Patent Laid-open No. Hei 8-46704 or the corresponding European Patent Publication No. EP696018A2. Voice chat allows those who unskilled with keyboard operation to enjoy chat.

However, in the invention disclosed in the above-mentioned document, only the loudness of the voice of

an avatar is changed with respect to the distance and direction of the avatar; in other words, nothing but a contrivance is made to provide presence similar to that in a so-called real space. Consequently, a problem still remains unsolved to allow users to enjoy the voice chat unique to a virtual reality space.

### SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an apparatus, a method, and a medium for use in a three-dimensional virtual reality space that allow the voice chat unique to a virtual reality space.

An information processing unit in a three-dimensional virtual reality space sharing system described in claim 1 includes a voice capturing means for capturing a voice uttered by a user, as voice data corresponding to an avatar corresponding to the user; a voice data transfer means for sending the voice data captured by the voice capturing means and receiving the voice data transmitted; a converting means for converting the voice data to be transmitted or received by the voice data transfer means into a voice data having a different quality based on a preset parameter; and a voice reproducing means for reproducing the voice data outputted from the converting means.

An information processing method for use in a three-dimensional virtual reality space sharing system described in claim 9 includes the steps of: capturing a voice uttered by a user, as voice data corresponding to an avatar corresponding to the user; sending the voice data captured by the voice capturing means and receiving the voice data transmitted; converting the voice data to be transmitted or received by the voice data transfer means into a voice data having a different quality based on a preset parameter; and reproducing the voice data outputted from the converting means.

A medium for storing or transmitting a computer program to be executed by an information processing apparatus for use in a three-dimensional virtual reality space sharing system described in claim 10, the computer program including the steps of: capturing a voice uttered by a user, as voice data corresponding to an avatar corresponding to the user; sending the voice data captured by the voice capturing means and receiving the voice data transmitted; converting the voice data to be transmitted or received by the voice data transfer means into a voice data having a different quality based on a preset parameter; and reproducing the voice data outputted from the converting means.

According to the information processing apparatus described in claim 1, the information processing method described in claim 9, and the medium described in claim 10 for storing or transmitting a computer program to be executed by the information processing apparatus, voice data to be transferred is converted by the converting means into a voice data having a different quality based on the preset conversion parameter and the

resultant voice data having a different quality is sounded. Consequently, appropriately setting this conversion parameter allows the user to more varied voice chats than before while maintaining privacy unique to a virtual reality space.

It should be noted that the above-mentioned medium denotes not only a package medium such as a floppy disc or a CD-ROM disc storing a computer program but also a transmission medium for downloading a computer program via a network transmission medium such as the Internet for example.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will be apparent from the following detailed description of the preferred embodiments of the invention in conjugation with the accompanying drawings, in which:

FIG. 1 is a block diagram illustrating a cyberspace system practiced as one preferred embodiment of the invention;

FIG. 2 describes WWW (World Wide Web);

FIG. 3 is a diagram illustrating an example of a URL (Uniform Resource Locator);

FIG. 4 is a block diagram illustrating an example of the constitution of an information server terminal 10 of FIG. 1;

FIG. 5 is a block diagram illustrating an example of the constitution of a shared server terminal 11 of FIG. 1;

FIG. 6 is a block diagram illustrating an example of the constitution of a mapping server terminal 12 of FIG. 1;

FIG. 7 is a block diagram illustrating an example of the constitution of a client terminal 13 of FIG. 1;

FIG. 8 is a block diagram illustrating an example of a decoder of ATRAC;

FIG. 9 is a block diagram illustrating an example of the constitution of a server provider terminal 14 of FIG. 1;

FIG. 10 describes a virtual reality space formed by the cyberspace system of FIG. 1;

FIG. 11 describes a view field seen from avatar C of FIG. 9;

FIG. 12 describes a view field seen from avatar D of FIG. 9;

FIG. 13 describes an allocated space of a part of the cyberspace of FIG. 1;

FIG. 14 describes a view field seen from avatar C of FIG. 12;

FIG. 15 describes a view field seen from avatar F of FIG. 12;

FIG. 16 is a flowchart describing operations of the client terminal 13 (the service provider terminal 14) of FIG. 1;

FIG. 17 is a flowchart describing operations of the

information server terminal 10 of FIG. 1;

FIG. 18 is a flowchart describing operations of the mapping server terminal 12 of FIG. 1;

FIG. 19 is a flowchart describing operations of the shared server terminal 11 of FIG. 1;

FIG. 20 describes a communication protocol for the communication between the client terminal 13, the information server terminal 10, the shared server terminal 11, and the mapping server terminal 12 of FIG. 1;

FIG. 21 describes the case in which a plurality of shared server terminals exist for controlling update objects arranged in the same virtual reality space;

FIG. 22 is a block diagram illustrating another example of the constitution of the client terminal 13 of FIG. 1;

FIG. 23 describes destinations in which basic objects and update objects are stored;

FIG. 24 describes an arrangement of basic objects and update objects;

FIG. 25 describes software for implementing the cyberspace system of FIG. 1;

FIG. 26 describes software operating on the client terminal 13-1 of FIG. 1 and the shared server terminal 11-1 of FIG. 1;

FIG. 27 describes an environment in which the software of FIG. 26 operates;

FIG. 28 is an example of a user control table;

FIG. 29 is a schematic diagram illustrating a relationship between a visible area and a chat-enable area;

FIG. 30 is an example of another user control table;

FIG. 31 is a flowchart for describing voice tone parameter setting processing of voice chat;

FIG. 32 is another flowchart for describing voice tone parameter setting processing of voice chat;

FIG. 33 is a photograph showing a display example on the display of a multi-user menu;

FIG. 34 is a photograph showing a display example on a display of a voice tone select dialog box;

FIG. 35 is a flowchart for describing a voice chat operation;

FIG. 36 is a photograph showing a display example on the display of a multi-user window;

FIG. 37 is a photograph showing a display example on the display shown when public chat is performed;

FIG. 38 is a flowchart for describing another example of voice tone parameter setting processing of voice chat;

FIG. 39 is a flowchart for describing still another example of voice parameter setting processing of voice chat;

FIG. 40 is a flowchart for describing yet another example of voice parameter setting processing of voice chat;

FIG. 41 is a photograph showing another display example on the display of the multi-user menu;

FIG. 42 is a photograph showing a display example on the display of an avatar select dialog box;

FIG. 43 is a photograph showing a display example on the display of a voice tone select dialog box;

FIG. 44 is a photograph showing a display example on the display in the state in which an avatar is specified by the cursor;

FIG. 45 is a photograph showing a display example on the display of a message window;

FIG. 46 is a photograph showing a display example on the display of a private chat window;

FIG. 47 is a photograph showing another display example on the display of the message window;

FIG. 48 is a photograph showing another display example on the display of the private chat window;

FIG. 49 is a photograph showing still another display example on the display of the private chat window; and

FIG. 50 is a photograph showing yet another display example on the display of the private chat window.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

This invention will be described in further detail by way of example with reference to the accompanying drawings. In order to clarify the relationship between each of the means described in the claims and each of the preferred embodiments described below, each means is suffixed with the corresponding embodiment (one example) enclosed by parentheses as follows. However, this description enclosed in parentheses is not limited in any manner to the particular embodiment described.

An information processing apparatus described in claim 1 for use in a three-dimensional virtual space sharing system includes a voice capturing means for capturing a voice uttered by a user (for example, a microphone 46 of FIG. 7), as voice data corresponding to an avatar corresponding to the user; a voice data transfer means for sending the voice data captured by the voice capturing means and receiving the voice data transmitted (for example, a communication device 44 of FIG. 7); a converting means for converting the voice data to be transmitted or received by the voice data transfer means into a voice data having a different quality based on a preset parameter (for example, a filtering circuit 302 of FIG. 7); and a voice reproducing means for reproducing the voice data outputted from the converting means (for example, a speaker 47 of FIG. 7).

The information processing apparatus described in claim 2 is characterized by that the converting means (for example the filtering circuit 302 of FIG. 7) performs conversion processing on the pitch component of voice data, thereby converting the voice data into voice data having a different quality.

The information processing apparatus described in

claim 3 is characterized by that the voice data transmitting means (for example, the communication device 44 of FIG. 7) transmits the voice data captured by the voice capturing means along with the preset conversion parameter and the converting means (for example, the filtering circuit 302 of FIG. 7) converts the voice data received with the conversion parameter into the voice data having a different quality based on the conversion parameter.

The information processing apparatus described in claim 4 is characterized by that a parameter changing means for changing the conversion parameter (for example, a CPU 41 of FIG. 7 for executing the processing of step S63 of FIG. 31) is further provided.

The information processing apparatus described in claim 5 is characterized by that a storage means for storing the conversion parameter changed by the parameter changing means (for example, a registry file 50A of FIG. 7) is further provided.

The information processing apparatus described in claim 6 is characterized by that an external view changing means for changing the external view parameter of user avatar (for example, the CPU 41 of FIG. 7 for executing the processing of step S105 of FIG. 38) is further provided and the parameter changing means (for example, the CPU 41 of FIG. 7 for executing the processing of step S63 of FIG. 31) displays an operator screen (for example, a voice tone select dialog box 421 of FIG. 43) operatively associated with a change operation by the external view changing means.

The information processing apparatus described in claim 7 is characterized by that a compression and decompression means (for example, a compression and decompression circuit 301 of FIG. 7) is further provided for compressing the voice data captured by the voice capturing means by a predetermined band compression means and decompressing, by the corresponding decompression method, the voice data compressed by the predetermined compression method and received by the voice data transmitting means.

The information processing apparatus described in claim 8 is characterized by that the three-dimensional virtual reality space image and the user avatar described based on VRML (Virtual Reality Modeling Language) are displayed.

An information processing method described in claim 9 for use in a three-dimensional virtual reality space sharing system includes the steps of capturing a voice uttered by a user, as voice data corresponding to an avatar corresponding to the user (for example, step S83 of FIG. 35); sending the voice data captured by the voice capturing means and receiving the voice data transmitted (for example, steps S84 and S85 of FIG. 35); converting the voice data to be transmitted or received by the voice data transfer means into a voice data having a different quality based on a preset parameter (for example, step S83 of FIG. 35); and reproducing

the voice data outputted from the converting means (for example, step S86 of FIG. 35).

A medium described in claim 10 for storing or transmitting a computer program to be executed by an information processing apparatus for use in a three-dimensional virtual reality space sharing system described in claim 10, the computer program including the steps of: capturing a voice uttered by a user, as voice data corresponding to an avatar corresponding to the user (for example, step S83 of FIG. 35); sending the voice data captured by the voice capturing means and receiving the voice data transmitted (for example, steps S84 and S85 of FIG. 35); converting the voice data to be transmitted or received by the voice data transfer means into a voice data having a different quality based on a preset parameter (for example, step S83 of FIG. 35); and reproducing the voice data outputted from the converting means (for example, step S86 of FIG. 35).

In the following description, an object "avatar" representing user's after ego can move around inside a virtual reality space, enter in and walk off it. The avatar can change (or update) its states inside a virtual reality space. Therefore, such an object is hereafter referred to as an update object appropriately. On the other hand, an object representative of a building constituting a town in the virtual reality space is used commonly by a plurality of users and does not change in its basic state. Even if the building object changes, it changes autonomously, namely it changes independent of the operations made at client terminals. Such an object commonly used by a plurality of users is appropriately called a basic object hereafter.

The basic idea and concept of a virtual society is described by Hiroaki Kitano, Sony Computer Science Laboratories, as follows in his home page "Kitano Virtual Society (V1.0) (<http://www.csl.sony.co.jp/person/kitano/VS/concept.j.html>. 1995)":

"In the beginning of the 21st century, a virtual society would emerge in a network spanning all the world. People in every part of the world will make a society in which millions or hundred millions of people live in a shared space created in the network. A society that will emerge beyond the current Internet, CATV, and the so-called information super highway is a virtual society that I conceive. In the virtual society, people can not only perform generally the same social activities as those in the real world—enjoy shopping, have a chat, play games, do work, and the like—but also perform things that are possible only in the virtual society (for example, moving from Tokyo to Paris in an instant). Such a "society" would be implemented only by state-of-the-art technologies such as cyberspace constructing technologies that support a broadband network, high-quality three-dimensional presentation capability and bidirectional communications of voice, music and moving picture signals, and a large-scale distributed system that allows a lot of people to share the constructed space."

For further details, look at the above mentioned

home page.

The three-dimensional virtual reality space that implements the above-mentioned virtual society is a cyberspace system. The actual examples of the infrastructures for constructing this cyberspace system includes, at this point of time, the Internet, which is a world-wide computer network connected by a communications protocol called TCP/IP (Transmission Control Protocol/Internet Protocol) and the intranet implemented by applying the Internet technologies such as WWW (World Wide Web) to the in-house LAN (Local Area Network). Further, use of a broadband communication network based on FTTH (Fiber To The Home) in the future is proposed in which the main line system and the subscriber system are all constituted by fiber optics.

Meanwhile, for an information providing system available on the Internet, WWW developed by CERN (European Center for Nuclear Research) in Switzerland is known. This technology allows a user to browse information including text, image and voice for example in the hyper text form. Based on HTTP (Hyper Text Transfer Protocol), the information stored in a WWW server terminal is sent asynchronously to terminals such as personal computers.

The WWW server is constituted by server software called an HTTP demon and an HTML file in which hyper text information is stored. The hyper text information is described in a description language called HTML (Hyper Text Markup Language). In the description of a hyper text by HTML, a logical structure of a document is expressed in a format specification called a tag enclosed by "<" and ">". Description of linking to other information is made based in link information called an anchor. A method in which a location at which required information is stored by the anchor is URL (Uniform Resource Locator).

A protocol for transferring a file described in HTML on the TCP/IP network is HTTP. This protocol has a capability of transferring a request for information from a client to the WWW server and the requested hyper text information stored in the HTML file to the client.

Used by many as an environment for using WWW is client software such as Netscape Navigator (trademark) called a WWW browser.

It should be noted that demon denotes a program for executing control and processing in the background when performing a job in the UNIX environment.

Recently, a language for describing three-dimensional graphics data, called VRML (Virtual Reality Modeling Language) and a VRML viewer for drawing a virtual reality space described in this VRML on a personal computer or a workstation have been developed. VRML allows to extend WWW, set hyper text links to objects drawn by three-dimensional graphics, and follow these links to sequentially access WWW server terminals. The specifications of VRML version 1.0 were made public in May 26, 1995. Then, in November 9, 1995, a revised version in which errors and ambiguities

expressions are corrected was made public. The specifications are available from URL = <http://www.vrml.org/Specifications/VRML1.0/>.

Storing three-dimensional information described in the above-mentioned VRML in a WWW server terminal allows the construction of a virtual space expressed in three-dimensional graphics on the Internet. Further, use of the VRML viewer by using personal computers and the like interconnected by the Internet can implement the display of a virtual space based on three-dimensional graphics and the walk-through capability.

In what follows, examples in which the Internet is used for a network will be described. It will be apparent to those skilled in the art that FTTH may be used instead of the Internet to implement the virtual space.

It should be noted that Cyberspace is a coinage by William Gibson, a US science fiction writer, and was used in his "Neuromancer" (1984) that made him famous. Strictly speaking, however, the word Cyberspace first appeared in his "Burning Chrome" (1982). In these novels, there are scenes in which the hero attaches a special electrode on his forehead to connect himself to a computer to directly reflect on his brain a virtual three-dimensional space obtained by visually reconfiguring data on a computer network spanning all over the world. This virtual three-dimensional space was called Cyberspace. Recently, the term has come to be used as denoting a system in which a virtual three-dimensional space is used by a plurality of users via a network.

Now, referring to FIG. 1, there is shown an example of a constitution of a cyberspace (a three-dimensional virtual reality space provided via a network) system according to the present invention. As shown, in this preferred embodiment, host computers (or simply hosts) A through C, a plurality (three in this case) of client terminals 13-1 through 13-3, and any number (one in this case) of service provider terminal 14 are interconnected via a world-wide network 15 (a global communication network sometimes referred to as an information transmission medium herein) like the Internet 15 by way of example.

The host A constitutes a system of so-called WWW (World Wide Web) for example. Namely, the host A has information (or a file) to be described later. And, each piece of information (or each file) is related with a URL (Uniform Resource Locator) for uniformly specify that information. Specifying a URL allows access to the information corresponding to it.

To be more specific, the host A stores three-dimensional image data for providing three-dimensional virtual reality spaces (hereinafter appropriately referred to simply as virtual reality spaces) such as virtual streets in Tokyo, New York, and other locations for example. It should be noted that these three-dimensional image data do not change in their basic state; that is, these data include static data consisting of only basic objects such as a building and a road to be shared by a plurality

of users. If the basic state changes, it only reflects an autonomous change in the state of a merry-go-round or a neon. The static data are considered to be data that are not subject to update. The host A has an information server terminal 10 (a basic server terminal). The information server terminal 10 is adapted, when it receives a URL via the network 15, to provide the information corresponding to the received URL, namely a corresponding virtual reality space (in this case, a space consisting of only basic objects).

It should be noted that, in FIG. 1, there is only one host, namely the host A, which has an information server terminal for providing the virtual reality space (consisting of only basic objects) of a specific area. It is apparent that such a host may be installed in plural.

The host B has a shared server terminal 11. The shared server terminal 11 controls update objects that constitute a virtual reality space when put in it. The update objects are avatars for example representing users of the client terminals. Thus, the shared server terminal 11 allows a plurality of users to share the same virtual reality space. It should be noted, however, that the host B controls only the update objects located in a virtual reality space for only a specific area (for example, Tokyo) of the virtual reality spaces controlled by the host A. That is, the host B is dedicated to the virtual reality space of a specific area. Also, it should be noted that the network 15 is connected with, in addition to the host B, a host, not shown, having a shared server terminal for controlling update objects located in virtual reality spaces of other areas such as New York and London, stored in the host A.

The host C, like the host A, constitutes a WWW system for example and stores data including IP (Internet Protocol) addresses for addressing hosts (shared server terminals) that control update objects like the host B. Therefore, the shared server terminal addresses stored in the host C are uniformly related with URLs as with the case of the host A as mentioned above. In addition, the host C has a mapping server terminal 12 (a control server terminal). Receiving a URL via the network 15, the mapping server terminal 12 provides the IP address of the shared server terminal corresponding to the received URL via the network 15. It should be noted that FIG. 1 shows only one host, namely the host C, which has the mapping server terminal 12 for providing shared server terminal addresses. It will be apparent that the host C can be installed in plural.

The client terminal 13 (13-1, 13-2 or 13-3) receives a virtual reality space from the information server terminal 10 via the network 15 to share the received virtual reality space with other client terminals (including the service provider terminal 14), under the control of the shared server terminal 11. Further, the client terminal 13 is also adapted to receive specific services (information) using the virtual reality space from the service provider terminal 14.

The service provider terminal 14, like the client ter-

terminal 13, receives a virtual reality space to share the same with the client terminal 13 (if there is another service provider terminal, it also shares this space). Therefore, as far as the capability of this portion is concerned, the service provider terminal 14 is the same as the client terminal 13.

Further, the service provider terminal 14 is adapted to provide specific services to the client terminal 13. It should be noted that FIG. 1 shows only one service provider terminal 14. It will be apparent that the service provider terminal may be installed in plural.

The following briefly describes a WWW system constituted by the host A and the host C. Referring to FIG. 2, WWW is one of the systems for providing information from hosts X, Y, and Z to unspecified users (client terminals) via the network 15 (the Internet in the case of WWW). The information that can be provided in this system include not only texts but also graphics, images (including still images and moving pictures), voices, three-dimensional images, and hyper texts which combines all these information.

In WWW, a URL, or a form for uniformly represent these pieces of information is determined. Specifying a specific URL, each user can obtain the information corresponding to the specified URL. As shown in FIG. 3, each URL is composed of a protocol type for representing a service type (http in the preferred embodiment of FIG. 3, which is equivalent to a command for retrieving a file corresponding to a file name to be described later and send the retrieved file), a host name indicating a destination of the URL (in the embodiment of FIG. 3, www.csl.sony.co.jp), and a file name of data to be sent (in the embodiment of FIG. 3, index.html) for example.

Each user operates the client terminal to enter a URL for desired information. When the URL is entered, the client terminal references a host name, for example, contained in the URL. A link with a host (in the embodiment of FIG. 2, the host X for example connected to the Internet) addressed by the host name is established. Then, at the client terminal, the URL is sent to the linked host, namely the host X, via the Internet, requesting the host X for sending the information specified in the URL. In the host X, an HTTP demon (httpd) is operating on the information server terminal (the WWW server terminal). Receiving the URL, the information server terminal sends back the information specified in the URL to the client terminal via the Internet.

The client terminal receives the information from the information server terminal to display the received information on its monitor as required. Thus, the user can get the desired information.

Therefore, only storing in the host such data for describing elements (objects) for constituting a virtual reality space as shapes of basic objects (for example, a rectangular prism and a cone) and locations and attributes (color and texture for example) of these basic objects allows to provide the virtual reality space (consisting of only basic objects in this case) to unspecified

users. Namely, as long as the Internet is used for the network 15 and WWW is used, virtual reality spaces can be provided to unspecified users world-wide with ease and at a low cost because the Internet itself already spans almost all over the world and the description of the elements constituting each virtual reality space to be stored in hosts does not require to make changes to information servers (WWW server terminals) constituting WWW. It should be noted that the service for providing the description of the elements constituting a virtual reality space is upward compatible with existing services provided by WWW.

Storing in a specific host (a mapping server terminal) the IP addresses of other hosts as information also allows to provide the host IP addresses to unspecified users world-wide with ease.

It should be noted that it is difficult for a plurality of users to share the same virtual reality space if only the description (the data of three-dimensional image for providing the virtual reality space of a specific area) of elements constituting the virtual reality space is stored in a host constituting WWW. Namely, in WWW, the information corresponding to a URL is only provided to a user and therefore no control for information transfer is performed. Hence, it is difficult to transfer between users the above-mentioned change information of update objects by using WWW without changing its design. Therefore, in the cyberspace system of FIG. 1, the host B having the shared server terminal 11 and the host C having the mapping server 12 are installed to allow a plurality of users to share the same virtual reality space, details of which will be described later.

Next, FIG. 4 shows an example of the constitution of the information server terminal 10 that operates on the host A of FIG. 1. As shown in FIG. 4, the information server terminal 10 has a CPU 81 which performs a variety of processing operations according to a program stored in a ROM 82. In the information server 10, the above-mentioned HTTP demon is operating in the background. A RAM 83 stores data and program necessary for the CPU 81 to perform the variety of processing operations. A communication device 84 is adapted to transfer specific data with the network 15. A storage device 85 composed of a hard disc, an optical disc, and magneto-optical disc stores the data of the three-dimensional images for providing a virtual reality space of a specific area such as Tokyo or New York for example along with URLs as mentioned above.

FIG. 5 shows an example of the constitution of the shared server terminal 11 operating on the host B of FIG. 1. As shown, the shared server terminal has a CPU 21 which executes a variety of processing operations according to a program stored in a ROM 22. A RAM 23 appropriately stores data and a program necessary for the CPU 21 to execute the variety of processing operations. A communication device 24 transfers specific data with the network 15.

A display device 25 has a CRT (Cathode Ray Tube)

or an LCD (Liquid Crystal Display) for example and is connected to interface 28 to monitor images of the virtual reality space (composed of not only basic objects but also update objects) of an area controlled by the shared server terminal 11. The interface 28 is also connected with a microphone 26 and a loudspeaker 27 to supply a specific voice signal to the client terminal 13 and the service provider terminal 14 and monitor a voice signal coming from these terminals.

The shared server terminal 11 has an input device 29 on which a variety of input operations are performed via the interface 28. This input device has at least a keyboard 29a and a mouse 29b.

A storage device 30 composed of a hard disc, an optical disc, and a magneto-optical disc stores data of the virtual reality space of an area controlled by the shared server terminal 11. It should be noted that the data of the virtual reality space are the same as those stored in the storage device 85 of the information server terminal 10 (of FIG. 4). When these data are displayed on the display device 25, the virtual reality space of the area controlled by the shared server terminal 11 is displayed.

FIG. 6 shows an example of the constitution of the mapping server terminal 12 operating on the host C of FIG. 1. Components CPU 91 through communication device 94 are generally the same in constitution as those of FIG. 4, so that the description of the components of FIG. 6 is omitted in general. A storage device 95 stores addresses, along with URLs, for identifying shared server terminals that control update objects (in the embodiment of FIG. 1, only the shared server terminal 11 is shown; actually, other shared server terminals, not shown, are connected to the network 15).

FIG. 7 shows an example of the constitution of the client terminal 13 (actually, client terminals 13-1 through 13-3). The client terminal 13 has a CPU 41 which executes a variety of processing operations according to a program stored in a ROM 42. A RAM 43 appropriately stores data and a program necessary for the CPU 41 to execute the variety of processing operations. A communication device 44 transfers data via the network 15. A storage device 50 constituted by a hard disk drive for example is adapted to store the registry file 50A for storing a conversion parameter for converting a voice signal into a voice signal having a different quality through the filtering circuit 302.

A display device 45 has a CRT or an LCD for example which is adapted to display a three-dimensional image of CG (Computer Graphics) and a three-dimensional image taken by an ordinary video camera for example. A microphone 46 is used to output voice data to the shared server terminal 11. A speaker 47 outputs the voice data transmitted from the shared server terminal 11. An input device 49 is adapted to be operated when performing various input operations. A data compression and decompression circuit 301 compresses voice data captured by the microphone 46 or voice data

converted by the filtering circuit 302 by a predetermined high-efficiency coding method and decompresses the compressed voice data by the same coding method. The filtering circuit 302 changes the pitch and frequency of the voice data according to the conversion parameter stored in the registry file 50A, thereby converting the voice data into voice data having a different quality.

A specific constitution for implementing the compression and decompression circuit 301 and the filtering circuit 302 is disclosed in detail in Japanese Patent Laid-open No. Hei 08-308259 filed by the applicant hereof on November 19, 1996 and the US application specification made based on this publication. Namely, a voice coding method and a voice decoding method disclosed in this Japanese Patent Laid-open No. Hei 08-308259 perform sine wave analysis coding on a voice signal in a predetermined coding unit in which the voice signal is divided into the coding unit along time axis and, when taking out a linear predictive difference of the voice signal to process the coded data, change the pitch component of the voice coded data coded by sine wave analysis coding in a pitch converting block by predetermined arithmetic processing. This allows pitch control by simple processing and constitution when coding and decoding voice signals.

Further, various coding methods are known in which the statistical quality and human auditory sensation characteristic in time region and frequency region of an audio signal (including both a voice signal and an acoustic signal) are used for signal compression. These coding methods largely include coding in time region, coding in frequency region, and analysis and synthesis coding.

Highly efficient coding methods for coding voice signals for example include MBE (Multi-band Excitation) coding, SBE (Single-band Excitation) coding or sine wave synthesis coding, harmonic coding, SBC (Sub-band Coding), LPC (Linear Predictive Coding), DCT (Discrete Cosine Transform) coding, MDCT (Modified DCT), and FFT (Fast Fourier Transform) coding.

Meanwhile, when coding a voice signal by one of the above-mentioned coding methods and decoding the coded voice signal, it may be desired to change the pitch of the voice without changing its phoneme.

However, no pitch change is considered in the ordinary voice signal highly efficient coding and decoding apparatuses. It is therefore necessary to attach a separate pitch control apparatus for pitch change, which inevitably complicates equipment constitution.

Consequently, use of the voice coding method and voice decoding method according to the above-mentioned Japanese Patent Laid-open No. 08-308259 properly allows desired pitch control with simple processing and constitution without involving phoneme change when coding and decoding a voice signal.

The above-mentioned compression and decompression circuit 301 and the filtering circuit 302 are constituted by use of the voice signal coding method and



voice signal decoding method disclosed in the above-mentioned Japanese Patent Laid-open No. 08-308259.

It should be noted that voice data compression and decompression may also be performed in the communication device 44 by use of ATRAC (Adaptive Transform Acoustic Coding) and DSVD (Digital Simultaneous Voice and Data) for example. In this case, TrueSpeech I developed by DSP Group of US or Digitalk developed by Rockwell International Corp. of US is for example used for the communication device 44.

It should be noted that the details of DSVD are found in Nikkei Electronics, September 4, 1995 (No. 643), pp. 97-99 under title "DSVD Becoming International Standard: Incorporating Voice Compression Technology into Data Communication."

A keyboard 49a of the input device 49 is operated when entering text (including an URL) composed of specific characters and symbols. A mouse 49b is operated when entering specific positional information. A viewpoint input device 49c and a movement input device 49d are operated when changing the state of the avatar as an update object of the client terminal 13. That is, the viewpoint input device 49c is used to enter the viewpoint of the avatar of the client terminal 13, thereby moving the viewpoint of the avatar vertically, horizontally or in the depth direction. The movement input device is used to move the avatar in the forward and backward direction or the right and left direction at a specific velocity. It is apparent that the operations done through the viewpoint and movement input devices may also be done through the above-mentioned keyboard 49a and the mouse 49b.

A storage device 50 composed of a hard disc, an optical disc, and magneto-optical disc stores avatars (update objects) representing users. Further, the storage device 50 stores a URL (hereinafter appropriately referred to as an address acquisition URL) for acquiring an IP address of a shared server terminal for managing update objects to be located in the virtual reality space of each area stored in the information server terminal 10 (if there is an information server terminal other than the information server terminal 10, that information server terminal is included). The address acquisition URL is stored as associated with a URL (hereinafter appropriately referred to as a virtual reality space URL) corresponding to the data of the virtual reality space of that area. This setup allows to obtain the address acquisition URL for acquiring the IP address of the shared server terminal for controlling the virtual reality space of that area when the virtual reality space URL for the data of the virtual reality space for that area has been entered.

Interface 48 constitutes the data interface with a display device 45, a microphone 46, a loudspeaker 47, an input device 49, and the storage device 50.

The following briefly describes the above-mentioned coding method ATRAC. In ATRAC, a voice signal is divided into three frequency bands for example beforehand. A signal in each frequency band is con-

verted from analog to digital and the converted signal is taken out of a time window of a maximum of 11.6 ms. Modified DCT (Discrete Cosine Transform) is performed on the resultant signal, which is then converted into a signal of frequency component.

The division of a voice signal into three frequency bands beforehand is performed to prevent a pre-echo that is easily caused by a DCT operation. The pre-echo is a noise that is generated when returning audio data compressed by a DCT operation to information of time axis, in which a unique noise appears before an actual sound is heard. For example, a pre-echo tends to be conspicuous for an abrupt sound such as heard when clattering castanets.

The data converted by modified DCT into frequency axis is thinned out based on human auditory characteristic. For this thinning, minimum audible limit characteristic and auditory masking effect are used. Minimum audible limit characteristic denotes that, as the intensity of a sound lowers below a certain level, it is not heard by the human ear and the intensity varies with frequency. Masking effect denotes that, when a loud sound and a soft sound are generated in near frequencies, the sound is covered with the loud sound and becomes difficult to hear.

By use of these two auditory characteristics, frequency components are extracted in the order of importance in auditory sensation for data compression.

In reproduction, the compressed data is decompressed through a decoder to be returned to audio data of sampling frequency 44.1 KHz and 16-bit resolution. FIG. 8 shows an example of a constitution of this decoder.

To be more specific, reverse modified DCT is performed on data of high, intermediate, and low frequency bands by a reverse modified DCT circuit 311, a reverse modified DCT circuit 314, and a reverse modified DCT circuit 316 respectively to return the data to time axis information. The data of intermediate and low frequency bands are composed together by a composing filter 315. The resultant composed filter is further composed by a composing filter 313 with the data of high frequency band delay by a delay circuit 312.

FIG. 9 shows an example of the constitution of the service provider terminal 14 of FIG. 1. The components including a CPU 51 through a storage device 60 are generally the same as the components including the CPU 41 through the storage device 50 and therefore the description of the CPU 51 through the storage device 60 is omitted.

FIG. 10 shows schematically a virtual reality space that is provided by the information server terminal 10 of FIG. 1 and can be shared by a plurality of users under the control of the shared server terminal 11. As shown in FIG. 10, this virtual reality space constitutes a town, in which avatar C (avatar of the client terminal 13-1 for example) and avatar D (avatar of the client terminal 13-2 for example) can move around.

Avatar C sees an image as shown in FIG. 11 for example from the position and viewpoint in the virtual reality space. Namely, data associated with the basic objects constituting the virtual reality space are provided to the client terminal 13-1 from the information server terminal 10 to be stored in a RAM 43 (or a storage device 50). Then, from the RAM 43 (or the storage device 50), data are read out of a virtual reality space that can be seen when the same is seen from specific viewpoint and position and the read data are supplied to the display device 45. Then, when the viewpoint and position of avatar C are changed by operating a viewpoint input device 49c and a movement input device 49d, data corresponding the change are read from the RAM 43 (or the storage device 50) to be supplied to the display device 45, thereby changing the virtual reality space (the three-dimensional image) being displayed on the display device 45.

Further, data associated with another user's avatar (an update object) (avatar D of FIG. 11) that can be seen when the virtual reality space is seen from the current viewpoint and position are supplied to the client terminal 13-1 from the shared server terminal 11. Based on the supplied data, the display on the display device 45 is changed. Namely, in the state of FIG. 10, since avatar C is looking in the direction of avatar D, avatar D is displayed in the image (the virtual reality space) displayed on the display device 45 of the client terminal 13-1 as shown in FIG. 11.

Likewise, an image as shown in FIG. 12 is displayed on the display device 45 of the client terminal 13-2 to which avatar D corresponds. This displayed image is also changed by moving the viewpoint and position of avatar D. It should be noted that, in FIG. 10, avatar D is looking in the direction of avatar C, so that avatar C is displayed in the image (the virtual reality space) on the display device 45 of the client terminal 13-2 as shown in FIG. 12.

The service provider terminal 14 controls a part of the sharable virtual reality space provided by the information server terminal 10 and the shared server terminal 11. In other words, the service provider purchases a part of the virtual reality space from administrators (information providers who provide information of the virtual reality space) of the information server terminal 10 and the shared server terminal 11. This purchase is performed in the real space. Namely, upon request by a specific service provider for the purchase of the virtual reality space, the administrators of the information server terminal 10 and the shared server terminal 11 allocate a part of the requested virtual reality space to that specific service provider.

For example, assume that the owner (service provider) of the service provider terminal 14 lease a room in a specific building in the virtual reality space and use the room as a shop for electric appliances. The service provider provides information about commodities, for example televisions, to be sold in the shop. Based on

the information, the server terminal administrator creates three-dimensional images of the televisions by computer graphics and place the created images at specific positions in the shop. Thus, the images to be placed in the virtual reality space have been completed.

Similar operations are performed by other service providers to form the virtual reality space as a big town for example.

FIG. 13 is a top view of a virtual reality space (a room in a building in this example) to be occupied by the service provider owning the service provider terminal 14. In this embodiment, one room of the building is allocated to this service provider in which two televisions 72 and 73 are arranged with a service counter 71 placed at a position shown. The service provider of the service provider terminal 14 places his own avatar F behind the service counter 71. It will be apparent that the service provider can move avatar F to any desired position by operating a movement input device 59d of the service provider terminal 14.

Now, assume that avatar C of the client terminal 13-1 has come in this electric appliances shop as shown in FIG. 13. At this moment, an image as shown in FIG. 14 for example is displayed on the display device 45 of the client terminal 13-1, in correspondence to the position and viewpoint of avatar C. If avatar F is located behind the service counter 71, an image as shown in FIG. 15 is displayed on a display device 55 of the service provider terminal 14. As shown in FIGS. 14 and 15, the image viewed from avatar C shows avatar F, while the image viewed from avatar F shows avatar C.

As shown in FIG. 14, the image viewed from avatar C shows a cursor 74 to be used when a specific image is specified from the client terminal 13-1. Likewise, as shown in FIG. 15, a cursor 75 is shown for the service provider terminal 14 to specify a specific image.

Moving avatar C around the television 72 or 73 by operating the movement input device 49d of the client terminal 13-1 displays on the display device 45 the image corresponding to avatar C's moved position and viewpoint. This allows the user to take a close look at the televisions as if they were exhibited in a shop of the real world.

Also, when the user moves the cursor 74 by operating a mouse 49b and then click on avatar F, a conversation request signal is transmitted to the service provider terminal 14 corresponding to avatar F. Receiving the conversation request signal, the service provider terminal 14 can output, via a microphone 56, a voice signal to a loudspeaker 47 of the client terminal 13-1 corresponding to avatar C. Likewise, entering a specific voice signal from a microphone 46 of the client terminal 13-1 can transmit user's voice signal to a speaker 57 of the service provider terminal 14. Thus, the user and service provider can make conversation in a usual manner.

It is apparent that the conversation can be requested from avatar F (the service provider terminal 14) to avatar C (the client terminal 13-1).

When the cursor 74 is moved on the client terminal 13-1 and the image of the television 72 for example is clicked, the information (the provided information) describing the television 72 is provided in more detail. This can be implemented by linking the data of the virtual reality space provided by the information server terminal 10 with the description information about the television. It is apparent that the image for displaying the description information may be either three-dimensional or two-dimensional.

The specification of desired images can be performed also from the service provider terminal 14. This capability allows the service provider to offer the description information to the user in a more active manner.

If the service provider specifies avatar C with the cursor 75 by operating the mouse 59b, the image corresponding to the position and viewpoint of avatar C, namely, the same image as displayed on the display device 45 of the client terminal 13-1 can be displayed on the display device 55 of the service provider terminal 14. This allows the service provider to know where the user (namely avatar C) is looking at and therefore promptly offer information needed by the user.

The user gets explanations about the products, or gets the provided information or description information. If the user wants to buy the television 72 for example, he can buy the same actually. In this case, the user requests the service provider terminal 14 for the purchase via avatar F. At the same time, the user transmits his credit card number for example to the service provider terminal 14 (avatar F) via avatar C. Then, the user asks the service provider terminal for drawing an amount equivalent to the price of the television purchased. The service provider of the service provider terminal 14 performs processing for the drawing based on the credit card number and make preparations for the delivery of the purchased product.

The images provided in the above-mentioned virtual reality space are basically precision images created by computer graphics. Therefore, looking at these images from every angle allows the user to make observation of products almost equivalent to the observation in the real world, thereby providing surer confirmation of products.

Thus, the virtual reality space contains a lot of shops, movie houses and theaters for example. Because products can be actually purchased in the shops, spaces installed at favorable locations create actual economic values. Therefore, such favorable spaces themselves can be actually (namely, in the real world) purchased or leased. This provides complete distinction from the so-called television shopping system ordinarily practiced.

The following describes the operations of the client terminal 13 (or the service provider terminal 14), the information server terminal 10, the mapping server terminal 12, and the shared server terminal 11 with refer-

ence to the flowcharts of FIGS. 16 through 19.

Now, referring to FIG. 16, there is shown an example of processing by the client terminal 13 (or the service provider terminal 14). In step S1, the CPU 41 checks whether a virtual reality space URL has been entered or not. If no virtual reality space URL has been found, the processing remains in step S1. If a virtual reality space URL has been found in step S1, namely, if a virtual reality space URL corresponding to a desired virtual reality space entered by the user by operating the keyboard 49a has been received by the CPU 41 via interface 48, the process goes to step S2. In step S2, a WWW system is constituted as described with reference to FIG. 2 and the virtual reality space URL is transmitted from the communication device 44 via the network 15 to the information server terminal of a specific host (in this case, the information server terminal 10 of the host A for example) that has the information server terminal, thereby establishing a link.

Further, in step S2, an address acquisition URL related to the virtual reality space URL is read from the storage device 50 to be transmitted from the communication device 44 via the network 15 to the mapping server terminal of a specific host (in this case, mapping server terminal 12 of the host C for example) that constitutes the WWW system, thereby establishing a link.

Then, the process goes to step S3. In step S3, data (three-dimensional image data) of the virtual reality space or the IP address of the shared server terminal 12 corresponding to the virtual reality space URL received in step S2 or the address acquisition URL is received by the communication device 44.

Namely, in step S2, the virtual reality space URL is transmitted to the information server terminal 10. When this virtual reality space URL is received by the information server terminal 10, the data of the corresponding virtual reality space are transmitted to the client terminal 13 via the network 15 in step S22 of FIG. 17 to be described. Thus, in step S3, the data of the virtual reality space transmitted from the information server terminal 10 are received. It should be noted that the received virtual reality space data are transferred to the RAM 43 to be stored there (or first stored in the storage device 50 to be transferred to the RAM 43).

Also, in step S2, the address acquisition URL is transmitted to the mapping server terminal 12. When the address acquisition URL is received by the mapping server terminal 12, the IP address of the shared server terminal corresponding to the URL is transmitted to the client terminal 13 via the network 15 in step S32 of FIG. 18 to be described. Thus, in step S3, the IP address of the shared server terminal 12 transmitted from the mapping server 12 is received.

As described above, the address acquisition URL related to the entered virtual reality space URL corresponds to the IP address of the shared server terminal that controls the update object placed in the virtual reality space corresponding to that virtual reality space

URL. Therefore, for example, if the entered virtual reality space URL corresponds to a virtual reality space of Tokyo and the shared server terminal 11 owned by the host B controls the update objects placed in the Tokyo virtual reality space, the IP address of the shared server terminal 11 is received in step S3. Consequently, the user can automatically get the location (the IP address) of the shared server terminal that controls the virtual reality space of a desired area even if the user does not know which shared server terminal controls the update objects in a virtual reality space in which area.

It should be noted that, in steps S2 and S3, the processing of transmitting the virtual reality space URL and the address acquisition URL and receiving the virtual reality space data and the IP address is actually performed by transmitting the virtual reality space URL, receiving the data of the corresponding virtual reality space, transmitting the address acquisition URL, and then receiving the corresponding IP address in this order by way of example.

When the virtual reality space data and the shared server terminal IP address are received in step S3, the process goes to step S4. In step S4, a connection request is transmitted from the communication device 44 via the network 15 to the shared server terminal (in this case, the shared server terminal 11 for example) corresponding to the IP address (the shared server terminal IP address) received in step S3. This establishes a link between the client terminal 13 and the shared server terminal 11. Further, in step S3, after the establishment of the link, the avatar (namely, the update object) representing oneself stored in the storage device 50 is transmitted from the communication device 44 to the shared server terminal 11.

When the shared server terminal 11 receives the user's avatar, the same is then transmitted to the client terminals of other users existing in the same virtual reality space (in this case, that of Tokyo as mentioned above). Then, on the client terminals of other users, the transmitted avatar is placed in the virtual reality space, thus implementing the sharing of the same virtual reality space among a plurality of users.

It should be noted that, rather than providing the user's avatar from the client terminal 11 to the shared server terminal 11, a predetermined avatar may also be allocated from the shared server terminal 11 to each user who accessed the same. Also, in the client terminal 13, the avatar of the user himself who uses this terminal can be placed and displayed in the virtual reality space; in the real world, however, the user cannot see himself, so that it is desirable for the user's avatar not be displayed on that user's client terminal in order to make the virtual reality space as real as possible.

When the processing of step S4 has been completed, the process goes to step S5. In step S5, the data of the virtual reality space that can be seen when the same is seen from specific viewpoint and position are read from the RAM 43 by the CPU 41 to be supplied to

the display device 45. Thus, the specific virtual reality space is shown on the display device 45.

Then, in step S6, the communication device 44 determines whether update information of another user's avatar has been sent from the shared server terminal 11.

As described above, the user can update the position or viewpoint of his own avatar by operating the viewpoint input device 49c or the movement input device 49d. If the update of the position or viewpoint of the avatar is instructed by using this capability, the CPU 41 receives the instruction via the interface 48. According to the instruction, the CPU 41 performs processing for outputting positional data or viewpoint data corresponding to the updated position or viewpoint as update information to the shared server terminal 11. In other words, the CPU 41 controls the communication device 44 to transmit the update information to the shared server terminal 11.

Receiving the update information from the client terminal, the shared server terminal 11 outputs the update information to other client terminals in step S44 of FIG. 19 to be described. It should be noted the shared server terminal 11 is adapted to transmit the avatar received from the client terminal that requested for access to client terminals of other users, this avatar being transmitted also as update information.

When the update information has come as mentioned above, it is determined in step S6 that update information of the avatar of another user has come from the shared server terminal 11. In this case, this update information is received by the communication device 44 to be outputted to the CPU 41. The CPU 41 updates the display on the display device 45 according to the update information in step S7. That is, if the CPU 41 receives the positional data or viewpoint data from another client terminal as update information, the CPU 41 moves or changes (for example, the orientation of the avatar) the avatar of that user according to the received positional data or viewpoint data. In addition, if the CPU 41 receives the avatar from another client terminal, the CPU 41 places the received avatar in the currently displayed virtual reality space at a specific position. It should be noted that, when the shared server terminal 11 transmits an avatar as update information, the shared server terminal also transmits the positional data and viewpoint data of the avatar along with the update information. The avatar is displayed on the display device 45 according to these positional data and viewpoint data.

When the above-mentioned processing has come to an end, the process goes to step S8.

Meanwhile, if, in step S6, no update information of the avatar of another user has come from the shared server terminal 11, the process goes to step S8, skipping step S7. In step S8, the CPU 41 determines whether the position or viewpoint of the avatar of the user of the client terminal 13 has been updated or not by

operating the viewpoint input device 49c or the movement input device 49d.

In step S8, if the CPU 41 determines that the avatar position or viewpoint has been updated, namely, if the viewpoint input device 49c or the movement input device 49d has been operated by the user, the process goes to step S9. In step S9, the CPU 41 reads data of the virtual reality space corresponding to the position and viewpoint of the avatar of the user based on the entered positional data and viewpoint data, makes calculations for correction as required, and generates the image data corresponding to the correct position and viewpoint. Then, the CPU 41 outputs the generated image data to the display device 45. Thus, the image (virtual reality space) corresponding to the viewpoint and position entered from the viewpoint input device 49c and the movement input device 49d is displayed on the display device 45.

Further, in step S10, the CPU 41 controls the communication device 44 to transmit the viewpoint data or the positional data entered from the viewpoint input device 49c or the movement input device 49d to the shared server terminal 11, upon which process goes to step S11.

Here, as described above, the update information coming from the client terminal 13 is received by the shared server terminal 11 to be outputted to other client terminals. Thus, the avatar of the user of the client terminal 13 is displayed on the other client terminals.

On the other hand, in step S8, if CPU 41 determines that the avatar's position or viewpoint has not been updated, the process goes to step S11 by skipping steps S9 and S10. In step S11, the CPU 41 determines whether the end of the update data input operation has been instructed by operating a predetermined key on the keyboard; if the end has not been instructed, the process goes back to step S6 to repeat the processing.

Referring to the flowchart of FIG. 17, there is shown an example of the processing by the information server terminal 10. First, the communication device 84 determines in step S21, whether a virtual reality space URL has come from the client terminal 13 via the network 15. If, in step S21, the communication device 84 determines that no virtual reality space URL has come, the process goes back to step S21. If the virtual reality space URL has come, the same is received by the communication device 84, upon which the process goes to step S22. In step S22, the data of the virtual reality space related to the virtual reality space URL received by the communication device 84 are read by the CPU 81 to be transmitted via the network 15 to the client terminal 13 that transmitted the virtual reality space URL. Then, the process goes back to step S21 to repeat the above-mentioned processing.

FIG. 18 shows an example of the processing by the mapping server terminal 12. In the mapping server terminal 12, the communication device 94 determines in step S31, whether an address acquisition URL has

come from the client terminal 13 via the network 15. If no address acquisition URL has come, the process goes back to step S31. If the address acquisition URL has come, the same is received by the communication device 94, upon which the process goes to step S32. In step S32, the IP address (the IP address of the shared server terminal) related to the address acquisition URL received by the communication device 94 is read from the storage device 95 by the CPU 91 to be transmitted via the network 15 to the client terminal 13 that transmitted the address acquisition URL. Then, the process goes back to step S31 to repeat the above-mentioned processing.

FIG. 19 shows an example of the processing by the shared server terminal 11. In the shared server terminal 11, the communication device 24 determines, in step S41, whether a connection request has come from the client terminal 13 via the network 15. If no connection request has come, the process goes to step S43 by skipping step S42. If the connection request has come, that is, if the client terminal 13 has the connection request to the shared server terminal 11 in step S4 of FIG. 16, the communication link with the client terminal 13 is established by the communication device 24, upon which the process goes to step S42.

In step S42, a connection control table stored in the RAM 23 is updated by the CPU 21. Namely, it is necessary for the shared server terminal 11 to recognize the client terminal 13 with which the shared server terminal 11 is linked, in order to transmit update information coming from the client terminal 13 to other client terminals. To do so, when the communication link with client terminals has been established, the shared server terminal 11 registers the information for identifying the linked client terminals in the connection control table. That is, the connection control table provides a list of the client terminals currently linked to the shared server terminal 11. The information for identifying the client terminals include the source IP address transmitted from each client terminal as the header of TCP/IP packet and a nickname of the avatar set by the user of each client terminal.

Then, the process goes to step S43, in which the communication device 24 determines whether the update information has come from the client terminal 13. If, in step S43, no update information has been found, the process goes to step S45 by skipping step S44. If the update information has been found, namely, if the client terminal 13 has transmitted, in step S10 of FIG. 16, positional data and viewpoint data as the update information to the shared server terminal 11 (or, in step S4 of FIG. 16, the client terminal 13 has transmitted the avatar as the update information to the shared server terminal 11 after transmission of the connection request), the update information is received by the communication device 24, upon which the process goes to step S44. In step S44, the CPU 21 references the connection control table stored in the RAM 23 to

transmit the update information received by the communication device 24 to other client terminals than the client terminal which transmitted that update information. At this moment, the source IP address of each client terminal controlled by the connection control table is used.

It should be noted that the above-mentioned update information is received by the client terminal 13 in step S6 of FIG. 16 as described above.

Then, the process goes to step S45, in which the CPU 21 determines whether the end of processing has been instructed by the client terminal 13. If the end of processing has not been instructed, the process goes back to S41 by skipping step S46. If the end of processing has been instructed, the process goes to step S46. In step S46, the link with the client terminal 13 from which the instruction has come is disconnected by the communication device 24. Further, from the connection control table, the information associated with the client terminal 13 is deleted by the CPU 21, upon which the process goes back to step S41.

Thus, the control of the update objects is performed by the shared server terminal 11 and the control (or provision) of the basic objects is performed by the information server terminal 10 constituting the WWW of the Internet used world-wide, thereby easily providing virtual reality spaces that can be shared by unspecified users world-wide. It should be noted that the specifications of the existing WWW system need not be modified to achieve the above-mentioned objective.

Provision of the virtual reality space data by use of the WWW system need not create any new web browser because the transfer of these data can be made using related art web browsers such as the Netscape Navigator (trademark) offered by Netscape Communications, Inc. for example.

Moreover, because the IP address of the shared server terminal 11 is provided by the mapping server terminal 12, the user can share a virtual reality space with other users without knowing the address of the shared server terminal.

In what follows, a procedure of communications between the client terminal 13, the information server terminal 10, the shared server terminal 11, and the mapping server terminal 12 will be described with reference to FIG. 20. When the user desires to get a virtual reality space, the user enters the URL (the virtual reality space URL) corresponding to the virtual reality space of the desired area. Then, the entered URL is transmitted from the client terminal 13 to the information server terminal 10 (http). Receiving the URL from the client terminal 13, the information server terminal 10 transmits the data (three-dimensional scene data representing only basic objects) of the virtual reality space associated with the URL to the client terminal 13. The client terminal 13 receives and display these data.

It should be noted that, at this stage of processing, no link is established between the client terminal 13 and the shared server terminal 11, so that the client terminal

13 does not receive update information; therefore, a virtual reality space composed of only basic objects, namely a virtual reality space shown only a still street for example, is shown (that is, no update objects such as avatars of other users are displayed).

Further, the address acquisition URL related to the virtual reality space URL is transmitted from the client terminal 13 to the mapping server terminal 12. The mapping server terminal 12 receives the address acquisition URL to transmit the IP address (the IP address of a shared server terminal controlling update objects located in the virtual reality space of the area related to the virtual reality space URL, for example, the shared server terminal 11) related to the received address acquisition URL to the client terminal 13.

Here, it is possible that the IP address related to the address acquisition URL transmitted by the client terminal 13 is not registered in the mapping server terminal 12. Namely, a shared server terminal for controlling the update objects located in the virtual reality space of the area related to the virtual reality space URL may not be installed or operating for example. In such a case, the IP address of the shared server terminal cannot be obtained, so that a virtual reality space composed of only basic objects, a virtual reality space showing only a still street for example, is displayed. Therefore, in this case, sharing of a virtual reality space with other users is not established. Such a virtual reality space can be provided only by storing the virtual reality space data (namely, basic objects) in an information server terminal (a WWW server terminal) by the existing WWW system. This denotes that the cyberspace system according to the present invention is upward compatible with the existing WWW system.

Receiving the IP address (the IP address of the shared server terminal 11) from the mapping server terminal 12, the client terminal 13 transmits a connection request to a shared server terminal corresponding to the IP address, namely the shared server terminal 11 in this case. Then, when a communication link is established between the client terminal 13 and the shared server terminal 11, the client terminal 13 transmits the avatar (the three-dimensional representation of the user) representing itself to the shared server terminal 11. Receiving the avatar from the client terminal 13, the shared server terminal 11 transmits the received avatar to the other client terminals linked to the shared server terminal 11. At the same time, the shared server terminal 11 transmits the update objects (shapes of shared three-dimensional objects), the other users' avatars, located in the virtual reality space of the area controlled by the shared server terminal 11, to the client terminal 13.

In the other client terminals, the avatar of the user of the client terminal 13 is placed in the virtual reality space to appear on the monitor screens of the other client terminals. In the client terminal 13, the avatars of the other client terminals are placed in the virtual reality

space to appear on its monitor screen. As a result, all the users of the client terminals linked to the shared server terminal 11 share the same virtual reality space.

Then, when the shared server terminal 11 receives the update information from other client terminals, transmits the received update information to the client terminal 13. Receiving the update information, the client terminal 13 changes the display (for example, the position of the avatar of another user is changed). When the state of the avatar of the user of the client terminal 13 is changed by that user, the update information reflecting that change is transmitted from the client terminal 13 to the shared server terminal 11. Receiving this update information, the shared server terminal 11 transmits the same to the client terminals other than the client terminal 13. Thus, on these other client terminals, the state of the avatar of the user of the client terminal 13 is changed accordingly (namely, the state of the avatar is changed as the same has been changed by the user of the client terminal 13 on the same).

Subsequently, the processing in which the client terminal 13 transmits the update information about the avatar of its own and receives the update information from the shared server terminal 11 to change the display based on the received update information continues until the connection with the shared server terminal 11 is disconnected.

Thus, the sharing of the same virtual reality space is established by transferring the update information via the shared server terminal 11 among the users. Therefore, if the shared server terminal 11 and the client terminal 13 are located remotely, there occurs a delay in the communication between these terminals, deteriorating the response in the communication. To be more specific, if the shared server terminal 11 is located in US for example and users in Japan are accessing the same, update information of user A in Japan is transmitted to user B in Japan via US, thereby taking time until a change made by user A is reflected in user B.

To overcome such a problem, rather than installing only one shared server terminal in the world, a plurality of shared server terminals are installed all over the world. And the IP addresses of the plurality of shared server terminals are registered in the mapping server terminal 12 to make the same provide the IP address of the shared server terminal in the geographical proximity to the client terminal 13.

To be more specific, as shown in FIG. 21, a shared server terminals W1 and W2 for controlling the update objects placed in a virtual reality space (a three-dimensional space) such as an amusement park are installed in Japan and US respectively by way of example. When the users in Japan and US have received the data of the amusement park's virtual reality space, each user transmits an address acquisition URL related to a virtual reality space URL corresponding to the amusement park's virtual reality space to the mapping server terminal 12 (the same address acquisition URL is transmitted from

all users). At this moment, the users in Japan transmit the IP address of the shared server terminal W1 installed in Japan to the mapping server terminal 12, while the users in US transmit the IP address of the shared server terminal W2 installed in US to the mapping server terminal 12.

Here, the mapping server terminal 12 identifies the installation locations of the client terminals that transmitted the address acquisition URLs to the mapping server terminal in the following procedure.

In the communication in TCP/IP protocol, a source IP address and a destination IP address are described in the header of a TCP/IP packet.

Meanwhile, an IP address is made up of 32 bits and normally expressed in a decimal notation delimited by dot in units of eight bits. For example, an IP is expressed in 43.0.35.117. This IP address provides an address which uniquely identifies a source or destination terminal connected to the Internet. Because an IP address expressed in four octets (32 bits) is difficult to remember, a domain name is used. The domain name system (DNS) is provided to control the relationship between the domain names assigned to the terminals all over the world and their IP addresses. The DNS answers a domain name for a corresponding IP address and vice versa. The DNS functions based on the cooperation of the domain name servers installed all over the world. A domain name is expressed in "hanaya@ipd.sony.co.jp" for example, which denotes a user name, a host name, an organization name, an organization attribute, and country name (in the case of US, the country name is omitted) in this order. If the country name of the first layer is "jp", that terminal is located in Japan. If there is no country name, that terminal is located in US.

Using a domain name server 130 as shown FIG. 24, the mapping server terminal 12 identifies the installation location of the client terminal that transmitted the address acquisition URL to the mapping server terminal.

To be more specific, the mapping server terminal asks the domain name server 130 controlling the table listing the relationship between the source IP addresses of the requesting client terminal and the domain names assigned with the IP addresses for the corresponding domain name. Then, the mapping server terminal identifies the country in which a specific client terminal is installed based on the first layer of the domain name of the client terminal obtained from the domain name server 130.

In this case, since the client terminal used by each user and its shared server terminal are located in geographical proximity to each other, the above-mentioned problem of a delay, or the deterioration of response time is solved.

In this case, the virtual reality space provided to the users in Japan and US is the same amusement park's virtual reality space as mentioned above. However, since the shared server terminals that control the shar-



ing are located in both countries, the sharing by the users in Japan is made independently of the sharing by the users in US. Namely, the same virtual reality space is shared among the users in Japan and shared among the users in US. Therefore, in this case, the same virtual reality space is provided from the information server terminal 10, but separate shared spaces are constructed among the users in both countries, thereby enabling the users to make a chat in their respective languages.

However, it is possible for the users of both countries to share the same virtual reality space by making connection between the shared server terminals W1 and W2 to transfer update information between them.

The deterioration of response also occurs when the excess number of users access the shared server terminal 11. This problem can be overcome by installing a plurality of shared server terminals for controlling the update objects placed in the virtual reality space in the same area in units of specific areas, for example, countries or prefectures and making the mapping server terminal 12 provide the addresses of those shared server terminals which are accessed less frequently.

To be more specific, a plurality of shared server terminals W3, W4, W5, and so on are installed and the mapping server terminal 12 is made provide the IP address of the specific shared server terminal W3 for example for specific URLs. Further, in this case, communication is performed between the mapping server terminal 12 and the shared server terminal W3 for example to make the shared server terminal W3 transmit the number of client terminals accessing the shared server terminal W3 to the mapping server terminal 12. Then, when the number of client terminals accessing the shared server terminal W3 has exceeded a predetermined level (100 terminals for example, which do not deteriorate the response of the shared server terminal W3) and if the mapping server terminal 12 has received another URL, the mapping server terminal 12 provides the IP address of another shared server terminal W4 for example (it is desired that the W4 be located in the proximity to the shared server terminal W3).

It should be noted that, in this case, the shared server terminal W4 may be put in the active state in advance; however, it is also possible to start the shared server W4 when the number of client terminals accessing the shared server W3 has exceeded a predetermined value.

Then, communication is performed between the mapping server terminal 12 and the shared server terminal W4. When the number of client terminals accessing the shared server terminal W4 has exceeded a predetermined value, and the mapping server terminal 12 has received another URL, the mapping server terminal 12 provides the IP address of the shared server terminal W5 (however, if the number of client terminals accessing the shared server terminal W3 has dropped below the predetermined level, the mapping server terminal 12 provides the IP address of the W3).

This setup protects each of the shared server terminals W3, W4, W5 and so on from application of excess load, thereby preventing the deterioration of response.

It should be noted that the above-mentioned capability can be implemented by controlling by the mapping server terminal 12 the IP addresses of shared server terminals to be outputted for specific URLs, so that the client terminal 13 and the software operating on the same need not be modified.

The present embodiment has been described by taking the user's avatar for example as the update object to be controlled by the shared server terminal 11; it is also possible to make the shared server terminal control any other update objects than avatars. It should be noted, however, that the client terminal 13 can also control update objects in some cases. For example, an update object such as a clock may be controlled by the client terminal 13 based on the built-in clock of the same, updating the clock.

Further, in the present embodiment, the hosts A through C, the client terminals 13-1 through 13-3, and the service provider terminal 14 are interconnected via the network 15, which is the Internet; however, in terms of using the existing WWW system, the host A having the information server terminal 10 or the host C having the mapping server terminal 12 may only be connected with the client terminal 13 via the Internet. Further, if the user recognizes the address of the shared server terminal 11 for example, the host A having the information server terminal 10 and the client terminal 13 may only be interconnected via the Internet.

In addition, in the present embodiment, the information server terminal 10 and the mapping server terminal 12 operate on different hosts; however, if the WWW system is used, these server terminals may be installed on the same host. It should be noted that, if the WWW system is not used, the information server terminal 10, the shared server terminal 11, and the mapping server terminal 12 may all be installed on the same host.

Still further, in the present embodiment, the data of the virtual reality spaces for each specific area are stored in the host A (namely, the information server terminal 10); however, these data may also be handled in units of a department store or an amusement park for example.

In the above-mentioned preferred embodiments of the invention, the basic objects are supplied to each client terminal 13 via the network 15; however, it is also possible to store the basic objects in an information recording medium such as a CD-ROM and distribute the same to each user in advance. In this case, each client terminal 13 is constituted as shown in FIG. 22. To be more specific, in the embodiment of FIG. 22, a CD-ROM drive 100 is connected to the interface 48 to drive a CD-ROM 101 in which a virtual reality composed of basic objects is stored. The other part of the constitution is the same as that of FIG. 7.

Thus, provision of the data of basic objects from the



CD-ROM 101 eliminates the time for transferring the data via the network 15, increasing processing speed.

Alternatively, the data of basic objects supplied from the information server terminal 10 may be stored in the storage device 50 only for the first time to be subsequently read for use.

Namely, the basic object data can be stored in the storage device 85 of the information server terminal 10 (for the cases 1 through 3), the storage device 50 of the client terminal 13 (for the cases 4 through 6) or the CD-ROM 101 of the client terminal 13 (for the cases 7 through 9) as shown in FIG. 23.

On the other hand, the update object data can be stored in the storage device 85 of the information server terminal 10 (for the case 1) or the storage device 30 of the shared server terminal 11 (for the cases 2 through 9). In the case in which the update object data are stored in the shared server terminal 11, that shared server terminal may be the shared server terminal 11-1 in Japan (for the case 2, 5 or 8) or the shared server terminal 11-2 in US (for the case 3, 6 or 9) as shown in FIG. 24 for example. In this instance, the URL of the update object data is stored on the mapping server terminal 12.

If the update object data are stored on the information server terminal 10, the URL of the update object data is the default URL controlled by the information server terminal 10 (in the case of 1). Or if the shared server terminal 11 is specified by the user manually, the URL of update object data is the specified URL (in the case of 4 or 7).

Referring to FIG. 24, the data in each of the above-mentioned cases in FIG. 23 flows as follows. In the case 1, the basic object data are read from a VRML file (to be described later in detail) stored in an HDD (Hard Disk Drive), storage device of a WWW server terminal 121 operating as the information server terminal 10 to be supplied to the client terminal 13-1 for example via the Internet 15A operating as the network 15. The storage device of the WWW server terminal 121 also stores update object data. To be more specific, when the basic object data are read in the WWW server terminal 121, the URL of the corresponding update object data is stored as the default URL in the storage device of the WWW server terminal 121 in advance. From this default URL, the update object data are read to be supplied to the client terminal 13-1.

In the case 2, the basic object data are supplied from the WWW server terminal 121 to the client terminal 13-1 in Japan via the Internet 15A. On the other hand, the update object data are supplied from the shared server terminal 11-1 in Japan specified by the mapping server terminal 12 to the client terminal 13-1 via the Internet 15A.

In the case 3, the basic object data are supplied from the WWW server terminal 121 to the client terminal 13-2 in US via the Internet 15A. The update object data are supplied from the shared server terminal 11-2 in US

specified by the mapping server terminal 12 via the Internet 15A.

In the case 4, the basic object data are stored in advance in the storage device 50 of the client terminal 13-1 in Japan for example. The update object data are supplied from the shared server terminal 11-2 in US for example specified by the client terminal 13-1.

In the case 5, the basic object data are stored in advance in the storage device 50 of the client terminal 13-1. The update object data are supplied from the shared server terminal 11-1 in Japan specified by the mapping server terminal 12 via the Internet 15A.

In the case 6, the basic object data are stored in advance in the storage device 50 of the client terminal 13-2 in US. The update object data are supplied from the shared server terminal 11-2 in US specified by the mapping server terminal 12 to the client terminal 13-2 via the Internet 15A.

In the case 7, the basic object data stored in the CD-ROM 101 are supplied to the client terminal 13-1 in Japan for example via the CD-ROM drive 100. The update object data are supplied from the shared server terminal (for example, the shared server terminal 11-1 or 11-2) specified by the client terminal 13-1.

In the case 8, the basic object data are supplied from the CD-ROM 101 to the client terminal 13-1. The update object data are supplied from the shared server terminal 11-1 in Japan specified by the mapping server terminal 12 in Japan.

In the case 9, the basic object data are supplied from the CD-ROM 101 to the client terminal 13-2 in US. The update object data are supplied from the shared server terminal 11-2 in US specified by the mapping server terminal 12 via the Internet 15A.

In what follows, the software for transferring the above-mentioned virtual reality space data to display the same on the display device. In the WWW system, document data are transferred in a file described in HTML (Hyper Text Markup Language). Therefore, text data are registered as an HTML file.

On the other hand, in the WWW system, three-dimensional graphics data are transferred for use by describing the same in VRML (Virtual Reality Modeling Language) or E-VRML (Enhanced Virtual Reality Modeling Language). Therefore, as shown in FIG. 25 for example, a WWW server terminal 112 of remote host 111 constituting the above-mentioned information server terminal 10, the shared server terminal 11 or the mapping server terminal 12 stores in its storage device both HTML and E-VRML files.

In an HTML file, linking between different files is performed by URL. In a VRML or E-VRML file, such attributes as WWW Anchor and WWW Inline can be specified for objects. WWW Anchor is an attribute for linking a hyper text to an object, a file of link destination being specified by URL. WWW Inline is an attribute for describing an external view of a building for example in parts of external wall, roof, window, and door for exam-

ple. An URL can be related to each of the parts. Thus, also in VRML or E-VRML files, link can be established with other files by means of WWW Anchor or WWW Inline.

For application software (a WWW browser) for notifying a WWW server terminal of a URL entered in a client terminal in the WWW system to interpret and display an HTML file coming from the WWW server terminal, Netscape Navigator (register trade name) (hereafter referred to simply as Netscape) of Netscape Communications, Inc. is known. For example, the client terminal 13 also uses Netscape to use the capability for transferring data with the WWW server terminal.

It should be noted, however, that this WWW browser can interpret an HTML file and display the same; but this WWW browser cannot interpret and display a VRML or E-VRML file although it can receive these files. Therefore, a VRML browser is required which can interpret a VRML file and an E-VRML file and draw and display them as a three-dimensional space.

Details of VRML are disclosed in the Japanese translation of "VRML: Browsing & Building Cyberspace," Mark Pesce, 1995, New Readers Publishing, ISBN 1-56205-498-8, the translation being entitled "Getting to Know VRML: Building and Browsing Three-Dimensional Cyberspace," translated by Kouichi Matsuda, Terunao Gamaike, Shouichi Takeuchi, Yasuaki Honda, Junichi Rekimoto, Masayuki Ishikawa, Takeshi Miyashita and Kazuhiro Hara, published March 25, 1996, Prenticehall Publishing, ISBN4-931356-37-0.

The applicant hereof developed Community Place (trademark) as application software that includes this VRML browser.

Community Place is composed of the following three software programs:

#### (1) Community Place Browser

This is a VRML browser which is based on VRML 1.0 and prefetches the capabilities (motion and sound) of VRML 2.0 to support E-VRML that provides moving picture capability. In addition, this provides the multi-user capability which can be connected to Community Place Bureau. For the script language, TCL/TK is used.

#### (2) Community Place Conductor

This is a VRML authoring system which is based on E-VRML based on VRML 1.0. This tool can not only simply construct a three-dimensional world but also give a behavior, a sound, and an image to the three-dimensional world with ease.

#### (3) Community Place Bureau

This is used for a server terminal system for enabling people to meet each other in a virtual reality space constructed on a network, connected from the Commu-

nity Place Browser.

In the client terminals 13-1 and 13-2 shown in FIG. 24, Community Place Bureau Browser is installed in advance and executed. In the shared server terminals 11-1 and 11-2, Community Place Bureau is installed in advance and executed. FIG. 26 shows an example in which Community Place Bureau Browser is installed from the CD-ROM 101 and executed on the client terminal 13-1 and, in order to implement the shared server terminal capability and the client terminal capability on a single terminal, Community Place Bureau and Community Place Bureau Browser are installed from the CD-ROM 101 in advance and executed.

As shown in FIG. 25, Community Place Bureau Browser transfers a variety of data with Netscape as a WWW browser based on NCAPI (Netscape Client Application Programming Interface) (trademark).

Receiving an HTML file and a VRML file or E-VRML file from the WWW server terminal 112 via the Internet, Netscape stores the received files in the storage device 50. Netscape processes only the HTML file. The VRML or E-VRML file is processed by Community Place Browser.

E-VRML is an enhancement of VRML 1.0 by providing behavior and multimedia (sound and moving picture) and was proposed to the VRML Community, September 1995, as the first achievement of the applicant hereof. Then, the basic model (event model) for describing motions as used in E-VRML was inherited to the Moving Worlds proposal, one of the VRML 2.0 proposals.

In what follows, Community Place Browser will be outlined. After installing this browser, selecting "Manual" from "Community Place Folder" of "Program" of the start menu of Windows 95 (trademark) (or in Windows NT (trademark), the Program Manager) displays the instruction manual of the browser.

It should be noted that Community Place Browser, Community Place Conductor, Community Place Bureau, and the files necessary for operating these software programs are recorded in a recording medium such as the CD-ROM 101 to be distributed as a sample.

Operating environment of the browser:

The operating environment of the browser is as shown in FIG. 27. The minimum operating environment must be at least satisfied. However, Netscape Navigator need not be used if the browser is used as a standalone VRML browser. In particular, on using in the multi-user, the recommended operating environment is desirable.

Installing the browser:

The browser can be usually installed in the same way as Netscape is installed. To be more specific, vscplb3a.exe placed in the \Sony (trademark) directory of the above-mentioned CD-ROM 101 is used as follows

for installation.

- (1) Double-click vsqplb3a.exe. The installation package is decompressed into the directory indicated by "Unzip To Directory" column. The destination directory may be changed as required.
- (2) Click "Unzip" button. And the installation package is decompressed.
- (3) "12 files unzipped successfully" appears. Click "OK" button.
- (4) When "Welcome" windows appeared, click "NEXT" button.
- (5) Carefully read "Software License Agreement." If agreed, press "Yes" button; if not, press "No" button.
- (6) Check the directory of installation. Default is "Program Files\Sony\Community Place."
- (7) If use of the above-mentioned directory is not wanted, press "Browse" button and select another directory. Then, press "Next" button.
- (8) To read "readme" file here, click "Yes" button.
- (9) When the installation has been completed, click "OK" button.

Starting the browser:

Before starting the browser, setting of Netscape Navigator must be performed. If the browser is used standalone, this setting need not be performed; just select "Community Place Folder ... Community Place" of "Program" of the start menu and start. The following setting may be automatically performed at installation.

- (1) From "Options" menu of Netscape Navigator, execute "General Preference" and open "Preference" window. From the upper tab, select "Helper Applications."
- (2) Check "File type" column for "x-world/x-vrml". If it is found, go to (4) below.
- (3) Click "Create New Type" button. Enter "x-world" in "Mime Type" column and "x-vrml" in "Mime Sub-Type" column. Click "OK" button. Enter "wrl" in "Extensions" column.
- (4) Click "Launch the Application:" button. Enter the path name of Community Place Browser in the text column below this button. Default is "Program Files\Sony\Community Place\bin\vsqp.exe".
- (5) Click "OK" button.

Thus, the setting of Netscape Navigator has been completed. Start the browser as follows:

- (1) In "File..Open File" menu of Netscape, read "readme.htm" of the sample CD-ROM 101.
- (2) Clicking the link to the sample world, and Community Place is automatically started, loading the sample world from the CD-ROM 101.

Uninstalling the browser:

Execute "Uninstall" from "Community Place Folder" of "Program" of the start menu (or in Windows NT, the Program Manager), the browser will be uninstalled automatically.

Operating the browser:

The browser may be operated intuitively with the mouse 49b, the keyboard 49a, and the buttons on screen.

Moving around in the three-dimensional space:

In the three-dimensional space provided by VRML, such movements done in real world as forward, backward, rotate right and rotate left for example can be done. The browser implements such movements through the following interface:

By keyboard:

Each of the arrow keys, not shown, on the keyboard 49a generates the following corresponding movement:

- rotate right;
- ← rotate left;
- ↑ move forward; and
- ↓ move backward.

By mouse:

Operate the mouse all with its left button.

(1) Keep the left button of the mouse 49b pressed in the window of Cyber Passage and move the mouse

to the right for rotate right;

to the left for rotate left;

up for forward; and

down for backward.

The velocity of movement depends on the displacement of the mouse.

(2) With the Ctrl (Control) key, not shown, on the keyboard 49a kept pressed, click an object on screen to get to the front of the clicked object.

The following precautions are needed:

- If a collision with an object occurs, a collision sound

is generated and the frame of screen blinks in red. If this happens, any forward movement is blocked. Moving directions must be changed.

- If the user is lost or cannot see anything in the space, click "Home" button on the right of screen, and the user can return to the home position.

#### Jumping eye:

While navigating through a three-dimensional space, the user may be lost at occasions. If this happens, the user can jump up to have an overhead view around.

- (1) Click "Jump" button on the right of screen, and the user enters the jumping eye mode and jump to a position from which the user look down the world.
- (2) Click "Jump" button again, and the user goes down to the original position.
- (3) Alternatively, click any place in the world, and the user gets down to the clicked position.

#### Selecting an object:

When the mouse cursor is moved around on the screen, the shape of the cursor is transformed into a grabber (hand) on an object. In this state, click the left button of the mouse, and the action of the grabbed object can be called.

#### Loading a VRML file:

A VRML file can be loaded as follows:

- In Netscape, click the link to the VRML file;
- From "File..Open File" menu of Community Place Bureau, select the file having extension "wrl" on disc.
- In "File..Open URL" menu of Community Place Bureau, enter the URL.
- Click the object in the virtual space for which "URL" is displayed on the mouse cursor.

#### Operating toolbar buttons:

Buttons in the toolbar shown in FIG. 30 for example may be used to execute frequently used functions.

- "Back": Go back to the world read last.
- "Forward": Go to the world after going back to the previous world.
- "Home": Move to the home position.
- "Undo": Return a moved object to the original position (to be described later).
- "Bookmark": Attach a book to the current world or position.
- "Scouter": Enter in the scouter mode (to be described later).

"Jump": Enter in the jump eye mode.

#### Scouter mode:

Each object placed in a virtual world may have a character string as information by using the E-VRML capability.

- (1) Click "Scouter" button on the right of screen, and the user enters the scouter mode.
- (2) When the mouse cursor moves onto an object having an information label, the information label is displayed.
- (3) Click "Scouter" button again, and the user exits the scouter mode.

#### Moving an object around:

With "Alt" (Alternate) key, not shown, on the keyboard 49a pressed, press the left button of the mouse 49b on a desired object, and the user can move that object to a desired position with the mouse. This is like moving a coffee cup for example on a desk with the hand in the real world. In the virtual reality, however, objects that can be moved are those having movable attributes. It should be noted that a moved object may be restored to the position before movement only once by using "Undo" button.

#### Connecting to a multi-user server terminal:

This browser provides a multi-user capability. The multi-user capability allows the sharing of a same VRML virtual space among a plurality of users. Currently, the applicant hereof is operating Community Place Bureau in the Internet on an experimental basis. By loading a world called chatroom the server terminal can be connected to share a same VRML virtual space with other users, walking together, turning off a room light, having a chat, and doing other activities.

This capability is started as follows:

- (1) Make sure that the user's personal computer is linked to the Internet.
- (2) Load the Chatroom of the sample world into Cyber Passage Browser. This is done by loading "Sony\\readme.htm" from the sample CD-ROM 101 clicking "Chat Room".
- (3) Appearance of "Connected to VS Server" in the message window indicates successful connection.

Thus, the connection to the server has been completed. Interaction with other users is of the following two types:

- Telling others of an action:

This is implemented by clicking any of "Hello",

"Smile", "Wao!", "Wooo!!", "Umm...", "Sad", "Bye" and so on in the "Action" window. The actions include rotating the user himself (avatar) right or left 36 degrees, 180 degrees or 360 degrees.

- Talking with others:

This capability is implemented by opening the "Chat" window in "View..Chat" menu and entering a message from the keyboard 49a into the bottom input column.

Multi-user worlds:

The following three multi-user worlds are provided by the sample CD-ROM 101. It should be noted that chat can be made throughout these three worlds commonly.

#### (1) Chat Room

This is a room in which chat is made mainly. Some objects in this room are shared among multiple users. There are objects which are made gradually transparent every time the left button of the mouse is pressed, used to turn off room lights, and hop when clicked, by way of example. Also, there are hidden holes and the like.

#### (2) Play with a ball!!

When a ball in the air is clicked, the ball flies toward the user who clicked the ball. This ball is shared by all users sharing that space to play catch.

#### (3) Share your drawing

A whiteboard is placed in the virtual space. When it is clicked by the left button, the shared whiteboard is displayed. Dragging with the left button draws a shape on the whiteboard, the result being shared by the users sharing the space.

Use of Community Place Bureau allows the users using Community Place Browser to enter together a world described in VRML 1.0. To provide a three-dimensional virtual reality space for enabling this capability, a file described in VRML 1.0 must be prepared. Then, the Bureau (Community Place Bureau being hereinafter appropriately referred to simply as the Bureau) is operated on an appropriate personal computer. Further, a line telling the personal computer on which Bureau is operating is added to the VRML 1.0 file. The resultant VRML file is read into Community Place Browser (hereinafter appropriately referred to simply as the Browser), the Browser is connected to the Bureau.

If this connection is successful, the users in the virtual world can see each other and talk each other. Further, writing an appropriate script into the file allows each user to express emotions through a use of action

panel.

Community Place Browser provides interface for action description through use of TCL. This interface allows each user to provide behaviors to objects in the virtual world and, if desired, make the resultant objects synchronize between the Browsers. This allows a plurality of users to play a three-dimensional game if means for it are prepared.

To enjoy a multi-user virtual world, three steps are required, preparation of a VRML file, start of the Bureau, and connection of the Browser.

Preparing a VRML file:

First, a desired VRML 1.0 file must be prepared. This file is created by oneself or a so-called freeware is used for this file. This file presents a multi-user virtual world.

#### 20 Starting the Bureau:

The operating environment of Community Place Bureau is as follows:

CPU... 486SX or higher  
OS... Windows 95  
Memory... 12MB or higher

This Bureau can be started only by executing the downloaded file. When the Cyber Passage Bureau is executed, only a menu bar indicating menus is displayed. Just after starting, the Bureau is in stopped state. Selecting "status" by pulling down "View" menu displays the status window that indicates the current the Bureau state. At the same time, a port number waiting for connection is also shown.

Immediately after starting, the Bureau is set such that it waits for connection at TCP port No. 5126. To change this port number, pull down "options" menu and select "port". When entry of a new port number is prompted, enter a port number 5000 or higher. If the user does not know which port number to enter, default value (5126) can be used.

To start the Bureau from the stopped state, pull down "run" menu and select "start". The server terminal comes to be connected at the specified port. At this moment, the state shown in "status" window becomes "running".

Thus, after completion of the bureau preparations, when the Browser comes to connect to the Bureau, it tells the position of the Browser to another Browser or transfers information such as conversation and behavior.

The "status" window of the Bureau is updated every time connection is made by the user, so that using this window allows the user to make sure of the users existing in that virtual world.

#### Connection of the Browser:

Connection of the Browser requires the following two steps. First, instruct the Browser to which Bureau it is to be connected. This is done by writing an "info" node to the VRML file. Second, copy the user's avatar file to an appropriate direction so that you can be seen from other users.

#### Adding to a VRML file:

When writing a line specifying the Bureau to be connected to the VRML file, a name of the personal computer on which the Bureau is operating and the port number must be specified in the following format:

```
DEF VsServer Info {string"server name:port
number"}
```

The server terminal name is a machine name as used in the Internet on which the Bureau is operating (for example, fred.research.sony.com) or its IP address (for example, 123.231.12.1). The port number is one set in the Bureau.

Consequently, the above-mentioned format becomes as follows for example:

```
DEF VsServer Info {string"fred.research.sony.com:5126"}
```

In the example of FIG. 26, the IP address of the shared server terminal 11-1 is 43.0.35.117, so that the above-mentioned format becomes as follows:

```
DEF VsServer Info {string"43.0.35.117:5126"}
```

This is added below the line shown below of the prepared VRML file:

```
#VRML V1.0 ascii
```

#### Copying an avatar file:

When Community Place Browser gets connected to Community Place Bureau, the former notifies the latter of its avatar. When a specific avatar meets another, the Bureau notifies the other Browsers of the meeting information to make the specific avatar be displayed on the other Browsers. For this reason, it is required to copy the VRML file of the specific avatar to an appropriate place in advance.

The following further describes the operation of the browser (Community Place Browser) operating on the client terminal 13 and the bureau (Community Place Bureau) operating on the shared server terminal 11.

In the following description, the description format of VRML 2.0 (The Virtual Reality Modeling Language Specification Version 2.0) publicized on August 4, 1996

is presupposed. Also, in the following description, it is supposed that the browser correspond to VRML 2.0 and be capable of decoding a file described in this VRML 2.0 and displaying its three-dimensional virtual reality space.

The details of the VRML 2.0 specifications are publicized at:

URL = <http://www.vrml.org/Specifications/VRML2.0/>

Further, the details of the Japanese version of the VRML 2.0 specifications are publicized at:

URL = <http://www.webcity.co.jp/info/andoh/VRML/vrml2.0/spec-jp/index.html>

FIG. 28 shows an example of a user control table controlled by a shared server terminal 11 which can control 1024 users for example and is accessed by 64 users. As shown in the figure, this user control table lists user IDs and shared data such as nicknames for these user IDs, various parameters including attribute information indicative of whether avatars having these user IDs are chat-enabled or not, and shared space coordinates (x, y, z) of avatars having these user IDs.

FIG. 29 schematically shows a relationship between a visible area as viewed from an avatar of a desired user (for example, a user having user ID = 01) and a chat enable area as viewed from the same user. As shown in the figure, it is assumed that an avatar of a user having user ID 01 is located at coordinates (x01, 0, z01) in a three-dimensional virtual reality space expressed in coordinates (x, y, z). For the user of this avatar, a range having radius Rv from the avatar's position (x01, 0, z01) is a visible area. An image in this visible area in the direction of which the avatar is orientated is displayed on the display device 45 of the client terminal of that user.

If avatars of users having user IDs 02 through 11 exist in the visible area in this range having radius Rv, shared data associated with the avatars of user IDs 02 through 11 as shown in FIG. 30 is transferred from the shared server terminal 11 to the client terminal of user ID = 01. Therefore, on the display device 45 of the client terminal of user ID = 01, an image of that avatar is displayed if the avatars of user IDs = 02 through 11 exist at positions to which that avatar is directed.

As shown in FIG. 29, an area having radius Ra around the position of own avatar is a chat-enable area. If another avatar exists in the chat-enable area, the user can chat with that avatar (or its user). Radius Ra of this chat-enable area is smaller than radius Rv of the visible area. This prevents the text data inputted by the users of all avatars arranged in the visible area from coming. Namely, chat is enabled only with avatars comparatively near the own avatar, so that a chat like a conversation in a real space can be enjoyed.

In the display example of FIG. 29, there are 11 avatars in total in the visible area. Of these avatars, the avatars located inside the chat-enable area are seven except the own avatar, so that the user can chat with the corresponding seven users.

In the above-mentioned preferred embodiment, not only a text-based chat but also a voice chat based on a voice signal can be performed in a three-dimensional virtual reality space. And, in this voice chat, the voice of a user is not directly transmitted to another user but the voice can be converted into a voice unique to an avatar in the virtual reality space before transmission. The following describes setting processing to be performed before outputting a voice unique to an avatar (that is, unique in a three-dimensional virtual reality space) with reference to FIGS. 31 and 32.

First, in step S61, the CPU 41 of the client terminal 13 waits until the user indicates pull down of the multi-user menu. When the user indicates pull down, then, in step S62, the CPU 41 displays the multi-user menu.

To be more specific, in a state in which a main window 211 is displayed on the display device 45 as shown in FIG. 33, the user clicks an area in which "Multi User" is displayed on the main window 211 by operating the mouse, 49b to display the multi-user menu. At this point, a multi-user menu 412 is pulled down as shown in FIG. 33.

To change the voice of own avatar, the user moves the cursor to "Change Avatar Voice ..." among the items displayed in the multi-user menu 412 and clicks the mouse 49b. If this selection is not made, the multi-user menu disappears, then, back in step S61, the subsequent processing is repeated.

If, in step S63, item "Change Avatar Voice ..." is found selected, then, in step S64, the CPU 41 displays a voice tone select dialog box 421 in the main window 211 of the display device 45 in a superimposed manner as shown in FIG. 34. Then, the CPU 41 waits in step S65 until a recording button (REC) 222 on this voice tone select dialog box 421 is operated. When the recording button 422 is operated, then, in step S66, the CPU 41 samples the voice captured through the microphone 46 and stores a resultant signal into the storage device such as a hard disk unit for example.

Namely, at this point, the user speaks something into the microphone 46 for a test. A resultant voice signal is captured through the microphone 46 and sampled by a compression and decompression circuit 301 to be stored in the storage device 50. This processing continues until the user operates a stop button (STOP) 423 on the voice tone select dialog box or a preset recordable limit capacity is reached. The CPU 41 repeats the processing of step S66 until the stop button 423 is found operated in step S67 or the volume of the voice signal captured through the microphone 46 is found reached the preset recordable limit capacity in step S68. Then, in step S67, the CPU 41 ends the voice capturing processing in step S69 if the stop button 423 is found turned on in step S67 or the recordable limit capacity is found reached in step S68.

Next, in step S70, the CPU waits until one of four voice tone select radio buttons 424 displayed to the left of the voice tone select dialog box 421 is selected. Only

one of the four voice tone select buttons 424 can be selected at a time. If, in a state in which one button is selected, another is selected, the button selected last is enabled, clearing the button selected earlier.

The user selects one of the four voice tone select radio buttons 424 to select for own avatar one of four voice types "normal," "change tone," "robot," and "reverse intonation." When "normal" is selected, the voice inputted by the user as the voice of own avatar is outputted to the destination user without change. When "tone change" is selected, a voice having a tone of child voice (to be generated when a voice tone adjusting slider 425 is moved to the left in FIG. 34) or a voice having a tone of adult voice (to be generated when the voice tone adjusting slider 425 is moved to the right in FIG. 34) is transmitted. When "robot" is selected, a voice as if it were uttered by a robot is transmitted. If "reverse intonation" is selected, a slow voice is transmitted.

When one of the four voice tone select radio buttons 424 is selected, the CPU 41 changes in step S71 the voice tone parameter to a default value corresponding to the selection of step S70.

Next, in step S72, the CPU 41 determines whether the voice tone adjusting slider 425 has been operated. If the slider is found operated, then, in step S73, the voice tone parameter value set in step S71 is further finely adjusted according to the slide position. The user moves this voice tone adjusting slider 425 by dragging the slider by the mouse 49b to a desired position for the fine adjustment of the voice tone parameter value. When this processing comes to an end, then, in step S70, the subsequent processing is repeated.

If, in step S72, the voice tone adjusting slider 425 is found not operated, then, in step S74, the CPU determines whether a play (PLAY) button 426 has been operated. After specifying a predetermined voice tone by selecting the voice tone select radio button 424, the user moves the voice tone adjusting slider 425 for further fine adjustment. To listen the adjusted voice tone, the user turns on the play button 426 by operating the mouse 49b. Then, in step S75, the CPU 41 executes reproduction of the sampled voice by the adjusted voice tone.

Namely, the CPU 41 reads the voice data from the storage device 50 and supplies the read voice data to the filtering circuit 302. The filtering circuit 302 filters the inputted voice signal based on the voice tone parameters set by the voice tone select radio button 424 and the voice tone adjusting slider 425 and outputs the filtered voice signal to the speaker 47. Thus, the voice signal captured in step S66 is processed according to the above-mentioned voice parameters and the processed voice signal is outputted from the speaker 47.

When the reproduction processing in step S75 comes to an end, then, back in step S70, the subsequent processing is repeated.

If, in step S74, the play button 426 is found not oper-

ated, then, in step S76, the CPU determines whether an OK button 427 has been turned on. If the OK button 427 is found not turned on, then, in step S77, the CPU determines whether a cancel button 428 has been turned on. If the cancel button 428 is found not turned on either, then, back in step S70, the subsequent processing is repeated.

If the user approves that the listened voice is transmitted to another user as the voice of own avatar, the user turns on the OK button 427 by operating the mouse 49b. Then, the CPU 41, in step S78, stores the set parameters in the registry file 50A as conversion parameters. On the other hand, to end the voice tone setting operation, the user turns on the cancel button 428 by operating the mouse 49b. At this point, the processing of step S78 for storing the voice tone parameters into the registry file 50A as conversion parameters is skipped, upon which the voice tone parameter setting processing comes to an end. Namely, the voice tone parameter remains as a default value (for example, "normal") and the conversion parameters stored in the registry file 50A remain default values.

If the adjusted voice tone does not satisfy user preference and therefore the user wants to redo the voice tone parameter setting processing, the user goes back to step 70 without operating neither the OK button 427 nor the cancel button 428 and performs input operations from the processing of selecting the voice tone select radio button 424 all over again.

Thus, to execute a voice chat upon completion of the voice tone parameter setting processing, the CPU 41 of the client terminal 13 executes the processing shown in the flowchart of FIG. 35.

First, in step S81, the CPU determines whether the voice chat mode is selected. If the voice chat mode is found not selected, the voice chat processing comes to an end. To perform a voice chat, the user selects item "Voice Chat: in the multi-user menu 412. At this point, the CPU 41 sets the voice chat mode. Then, in step S82, the CPU 41 determines whether the speech send mode is to be set. If a voice signal over a predetermined level has been inputted from the microphone 46, the CPU 41 sets the speech send mode; if a voice signal over a predetermined level has not been captured from the microphone 46 for a predetermined duration of time, the CPU 41 sets the speech receive mode.

Alternatively, when performing a speech send operation, the CPU can make the user operate a predetermined key among those on the keyboard 49a and, if that key is not operated, set the speech receive mode.

In the speech send mode, the voice data captured through the microphone 46 is converted by filtering into a voice signal having a different quality in step S83. Namely, at this point, the user puts a message in voice into the microphone 46. This voice data is supplied under the control of the CPU 41 to the filtering circuit 302 to be filtered according to the conversion parameter stored in the registry file 50A. Then, in the next step

S84, the voice data filtered by the filtering circuit 302 is compressed by the compression and decompression circuit 301 and the compressed voice data is transmitted from the network 15 to the shared server terminal 11 via the communication device 44. The shared server terminal 11 transmits this compressed voice data to the avatar of the user located in the chat-enabled area described with reference to FIG. 29. Therefore, the user whose avatar is located in this chat-enabled area can hear that voice data.

If, in step S82, the set mode is found the speech receive mode, then, in step S85, the CPU 41 receives at the communication device 44 the voice data transmitted from the shared server terminal 11 to decompress the received voice data. To be more specific, the voice data received by the communication device 44 is inputted in the compression and decompression circuit 301 to be decompressed. Then, in step S86, the voice data decompressed by the compression and decompression circuit 301 is outputted from the speaker 47. Consequently, the voice of the user of the avatar located in the chat-enabled area can be heard.

As described above, this voice has been changed to the voice tone set by the user. If desired, each user can convert his or her voice to a child voice for example and transmits the converted voice to another user. Therefore, each user can enjoy a voice chat that can be realized only in a three-dimensional virtual reality space.

It should be noted that, in order to recognize the voice of each user of the avatar located in the chat-enabled area, the voice data transmitted from the shared server terminal 11 to each client terminal 13 is transmitted to each client terminal along with the ID (the ID of the avatar corresponding to the voice data) of the client terminal from which the voice data has been transmitted to the shared server terminal 11. In this case, at each client terminal 13, the nickname for example of the avatar is displayed for easy recognition of what the avatar is speaking on the corresponding avatar when the voice data is decompressed, filtered, and outputted.

Further, in the processing shown by the flowchart of FIG. 35, the voice data of the user captured through the microphone 46 is filtered based on the conversion parameter stored in the registry file 50A, compressed, and transmitted to the destination client terminal 13. It will be apparent to those skilled in the art that the voice data may only be compressed without filtering at the transmitting client terminal 13 and the compressed data may be transmitted to the destination client terminal 13 along with the conversion parameter. In this case, at the receiving client terminal 13, the voice data is decompressed and the decompressed voice data is filtered based on the conversion parameter transmitted with the voice data.

FIGS. 36 and 37 illustrate display examples of the display device 45 in the voice chat mode. To select the voice chat mode in step S81 of FIG. 35, the user selects



item "Voice Chat" in the multi-user menu 412. Then, the multi-user window 212 is displayed next to the main window 211 as shown in FIG. 36. Further, when item "Connect" in the multi-user menu 412 is clicked by the mouse 49b, the CPU 41 controls the communication device 44 to make the same access the shared server terminal 11. When the access is completed, the display in the lower right side of the multi-user menu 412 in which two figures are separated from each other is replaced by the display in which the two figures hold each other's hand, by which the user can recognize completion of the connection to the shared server terminal 11.

FIG. 37 shows a display example in which a plurality of avatars located in a chat-enabled area are chatting in voice with each other. As shown in the same figure, the name (nickname) of the avatar speaking at that time is displayed as "kamachi" or "tama" for example in the "Chat Log" area of the multi-user window 212. This allows the user to know which avatar is speaking.

It will be apparent that the speaking avatar may also be recognized by coloring red for example of the face of the speaking avatar differently from other avatars or making the mouth of the speaking avatar open and close.

If two or more avatars in a chat-enabled area transmit voice signals simultaneously, the two voice signal may be reproduced simultaneously as in a real space or a time delay may be placed between the two voice signals.

The setting processing shown in the flowcharts of FIGS. 31 and 32 does not consider voice tone parameter setting in correspondence with each selected avatar. As a result, a voice tone parameter unsuitable to a particular avatar may be set unintentionally. To prevent this problem from happening, setting processing is preferably used that allows the user to select a particular avatar and set a voice tone parameter while looking at the selected avatar. This enhances ease of operation in voice tone parameter setting. Flowcharts of FIGS. 38 through 40 show the setting processing that satisfies this requirement.

To be more specific, first in step S101, the CPU waits until pull down of the multi-user menu is indicated. When pull down of the multi-user menu is indicated, then, in step S102, the multi-user menu is displayed. FIG. 41 shows a display example of the multi-user menu 412 at this moment. In this display example, there is an item "Select Avatar ..." in the multi-user menu 412. In step S103, the CPU determines whether this item has been selected or not. If this item is found not selected, then, back in step S101, the subsequent processing is repeated.

If, in step S103, the item "Select Avatar ..." is found selected, then in step S104, an avatar select dialog box 331 is displayed as shown in FIG. 42. As shown in FIG. 42, this avatar select dialog box 331 displays avatars to be selected. In this display example, two avatars, male and female, are displayed as selectable avatars; actu-

ally more avatars may be displayed.

The user selects one avatar as his or her own avatar from among the displayed avatars. In step S105, the CPU 41 waits until a desired avatar is selected. When the desired avatar is selected by the user, then, in step S106, the CPU stores the voice tone parameter of the selected avatar into the register 41A. Namely, for each avatar, a default voice tone parameter is set beforehand and stored in the register.

Next, in step S107, the CPU determines whether a voice button 332 in the avatar select dialog box 331 has been selected. If the voice button 332 is found not selected, the voice tone parameter setting processing comes to an end. Namely, in this case, the default voice tone parameter is set without change.

On the other hand, if the user selects one avatar and wants to set a voice tone parameter other than the default parameter, the user operates the voice button 332. When the voice button 332 is operated, then in step S108, the voice tone select dialog box shown in FIG. 43 is displayed on the main menu 211. In steps S109 through S122, the same processing as those of steps S65 through S78 shown in FIGS. 31 and 32 is performed for voice tone parameter setting.

Thus, in the above-mentioned setting processing, avatar selection is followed by the processing for setting a voice tone parameter to the selected avatar, thereby facilitating the setting of a voice tone parameter suitable for the selected avatar.

The above-mentioned voice chat operations have been described as public chats which are carried out between all avatars located in a chat-enabled area. It will be apparent that a one-to-one chat between specified avatars (this is called a private chat) may be provided.

The following describes an example of a one-to-one voice private chat with reference to FIGS. 44 through 50.

When the cursor 201 is moved onto a predetermined object, if this object is not chat-enabled, the cursor is displayed in the shape of an arrow; if the object is chat-enabled, the cursor is displayed in a shape symbolizing a human face that makes the user recognize a human mouth. The cursor 201 of FIG. 44 shows a display example of this case. When the cursor is moved onto an avatar, the nickname (in the display example of FIG. 44, "kamachi") of the avatar is displayed in alphabet on that avatar.

When the user clicks the mouse 49b, the message window 221 is displayed as shown in FIG. 45, in which the OK button and the cancel button are displayed along with message "Do you want to chat with kamachi?"

If the user wants a chat, the user operates the OK button in the message window 221; if not, the user operates the cancel button. Each button is operated by moving the cursor onto the button by operating the mouse 49b and clicks the same.

On the other hand, if the user operates the OK but-

ton the private chat window 231 is displayed as shown in FIG. 46. The private chat window 231 is separate from the public chat window displayed in the multi-user window. Therefore, the user may distinctively recognize the chat to be carried out is a one-to-one private chat.

The above-mentioned processing may all be performed at the client terminal 13. However, the chat itself requires data transfer with the mate client terminal, so that the subsequent processing must be performed via the shared server terminal 11. To be more specific, when the OK button is selected, the client terminal 13 of the user who operated the OK button outputs, to the shared server terminal 11, a request for a chat with the client terminal corresponding to specified avatar kamachi, via the network. In the private chat window 231 of the requesting user, message "Calling" is displayed as shown in FIG. 46.

On the other hand, the shared server terminal 11 notifies the client terminal of the user of avatar kamachi of the request for a chat. In response, the requested client terminal displays the message window 243 on the main window 241 and the multi-user window 242 as shown in FIG. 47 and displays message "tama wants a chat with you; do you accept the request?" for example in the message window along with the OK button and the cancel button. If the requested user wants a chat with tama, he or she clicks the OK button; if not, the cancel button.

If the OK button is clicked, the selection is transmitted to the client terminal 13 of avatar tama via the shared server terminal 11. Then, message "Answered" is displayed in the private chat window 231 of the user (of avatar tama) who requested a chat with avatar kamachi as shown in FIG. 48. On the display of the client terminal of avatar kamachi, as shown in FIG. 49, the private chat window 251 is shown on the main window 241. This private chat window 251 is shown separately from the multi-user window 242. It should be noted that avatar tama who requested for a chat is displayed on the main window 241 of the display device 45 of avatar kamachi.

Thus, when the chat window is displayed on each main window, an actual voice chat starts. Namely, the user of avatar tama inputs a voice signal in the microphone 46 of the client terminal 13 of that user. The inputted voice signal is compressed by the compression and decompression circuit 301 in the same manner as mentioned above and the compressed voice signal is transmitted from the communication device 44 to the network 15 along with a voice tone parameter stored in the register 41A. This data is transmitted to the terminal 13 of avatar kamachi via the shared server terminal 11.

At the client terminal of avatar kamachi, the transmitted voice data is received by its communication device 44 and the received voice signal is decompressed by its compression and decompression circuit 301. Further, the decompressed voice data is filtered by the filtering circuit 302 along with the voice tone param-

eter attached to this voice data and the filtered voice data is outputted from the speaker 47.

Likewise, the voice data inputted by the user of avatar kamachi through the microphone 46 of the client terminal 13 of that user is outputted from the speaker 47 of the client terminal 13 of avatar tama. FIG. 50 illustrates a display example of the private chat window 231 at the side of avatar tama to be displayed when a private voice chat is thus carried out. In a text-based chat, inputted characters are displayed like "Long time no see" for example. In a voice chat, "Long time no see" is voiced from the speaker 47 without displaying the characters. Instead, the nickname of the speaking avatar is displayed on the private chat window 231.

If desired, an avatar with which a chat is to be made may be selected from a list of avatar nicknames. However, selection from such a list retards a prompt private chat. Therefore, it is preferable to use the above-mentioned constitution that allows execution of a private chat as soon as a desired avatar for the private chat is selected.

The description so far has been made by using the Internet for the network 15 and by using WWW for example. It will be apparent to those skilled in the art that the present invention can also be implemented by use of a broadband communication network other than the Internet for the network 15 and by use of a system other than WWW.

Also, the computer program to be executed by the CPU 41 can be recorded and distributed by use of information recording media such as an FD (Floppy Disc) and a CD-ROM or transmitted via network media such as the Internet and a digital satellite.

As described and according to the information processing apparatus described in claim 1 for use in a three-dimensional virtual reality space sharing system, the information processing method described in claim 9 for use in a three-dimensional virtual reality space sharing system, and the medium described in claim 10 for storing or transmitting the computer program to be executed by the above-mentioned information processing apparatus, voice data to be transferred is converted by a converting means into voice data having a different quality based on preset conversion parameters and the converted voice data is sounded. This novel constitution allows the user to enjoy more varied voice chats than before while maintaining privacy unique to a virtual reality space by appropriately setting these conversion parameters.

While the preferred embodiments of the present invention have been described using specific terms, such description is for illustrative purposes only, and it is to be understood that changes and variations may be made without departing from the spirit or scope of the appended claims.

# Claims

1. An information processing apparatus for use in a three-dimensional virtual reality space sharing system for displaying a three-dimensional virtual reality space image and transferring positional information about a user avatar in the displayed three-dimensional virtual reality space to display said user avatar at a corresponding position in the three-dimensional virtual reality space, said information processing apparatus comprising:
  - a voice capturing means (46) for capturing a voice uttered by a user, as voice data corresponding to an avatar corresponding to said user;
  - a voice data transfer means (48) for sending the voice data captured by said voice capturing means (46) and receiving the voice data transmitted;
  - a converting means (301,302) for converting said voice data to be transmitted or received by said voice data transfer means into a voice data having a different quality based on a preset parameter; and
  - a voice reproducing means (47) for reproducing the voice data outputted from said converting means.
2. The information processing apparatus according to claim 1, wherein said converting means (301, 302) converts a pitch component of said voice data to provide said voice data having a different quality.
3. The information processing apparatus according to claim 1 or 2, wherein said voice data transfer means (48) sends said voice data captured by said voice capturing means (46) by attaching said preset conversion parameter to said voice data and said converting means converts said voice data transmitted along with said preset conversion parameter into said voice data having a different quality based on said preset conversion parameter.
4. The information processing apparatus according to anyone of claims 1 to 3 further comprising a parameter changing means for changing said preset conversion parameter.
5. The information processing apparatus according to claim 2 further comprising a storage means (50) for storing a conversion parameter changed by said parameter changing means.
6. The information processing apparatus according to claim 4 further comprising an external view changing means (49) for changing an external view parameter of said user avatar, wherein said parameter changing means displays an operator screen for changing said conversion parameter in operative association with a changing operation by said external view changing means (49).
7. The information processing apparatus according to anyone of claims 1 to 6 further comprising a compressing and decompressing means (301) for compressing said voice data captured by said voice capturing means (46) by a predetermined band compressing method and decompressing, by a corresponding decompressing means, the voice data compressed by said predetermined band compressing method and received by said voice data transfer means (48).
8. The information processing apparatus according to anyone of claims 1 to 7, wherein said three-dimensional virtual reality space image and said user avatar described based on VRML (Virtual Reality Modeling Language) are displayed.
9. An information processing method for use in a three-dimensional virtual reality space sharing system for displaying a three-dimensional virtual reality space image and transferring positional information about a user avatar in the displayed three-dimensional virtual reality space to display said user avatar at a corresponding position in the three-dimensional virtual reality space, said information processing method comprising the steps of:
  - capturing (46) a voice uttered by a user, as voice data corresponding to an avatar corresponding to said user;
  - sending (48) the voice data captured by said voice capturing means and receiving said voice data transmitted;
  - converting (301, 302) said voice data to be transmitted or received by said voice data transfer means into a voice data having a different quality based on a preset parameter; and
  - reproducing (47) the voice data outputted from said converting means.
10. A medium for storing or transmitting a computer program to be executed by an information processing apparatus for use in a three-dimensional virtual reality space sharing system for displaying a three-dimensional virtual reality space image and transferring positional information about a user avatar in the displayed three-dimensional virtual reality space to display said user avatar at a corresponding position in the three-dimensional virtual reality space, said computer program comprising the steps of:
  - capturing (46) a voice uttered by a user, as

voice data corresponding to an avatar corresponding to said user;

sending (48) the voice data captured by said voice capturing means and receiving said voice data transmitted;

5

converting (301, 302) said voice data to be transmitted or received by said voice data transfer means into a voice data having a different quality based on a preset parameter; and

reproducing (47) the voice data outputted from said converting means.

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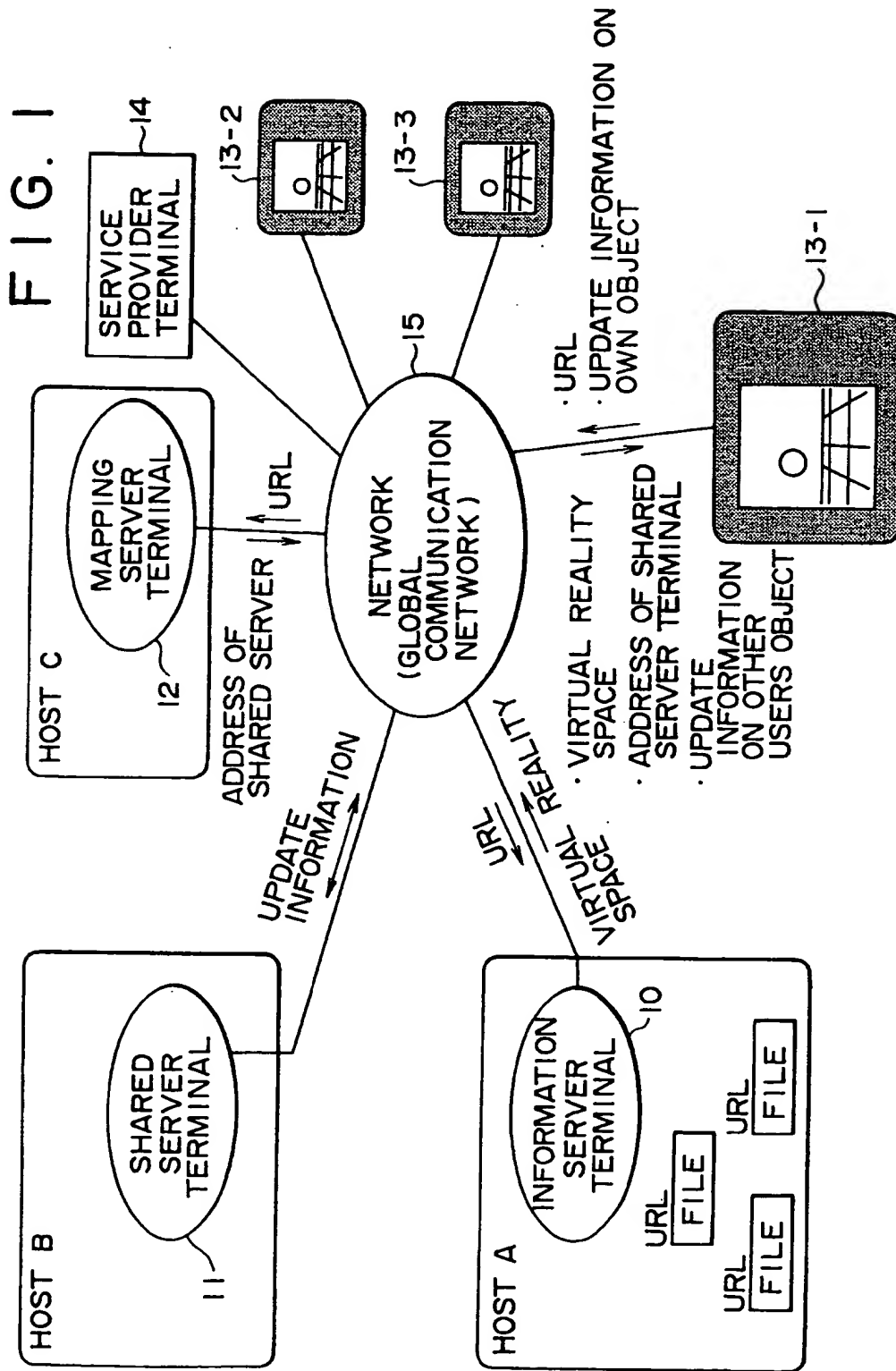


FIG. 2

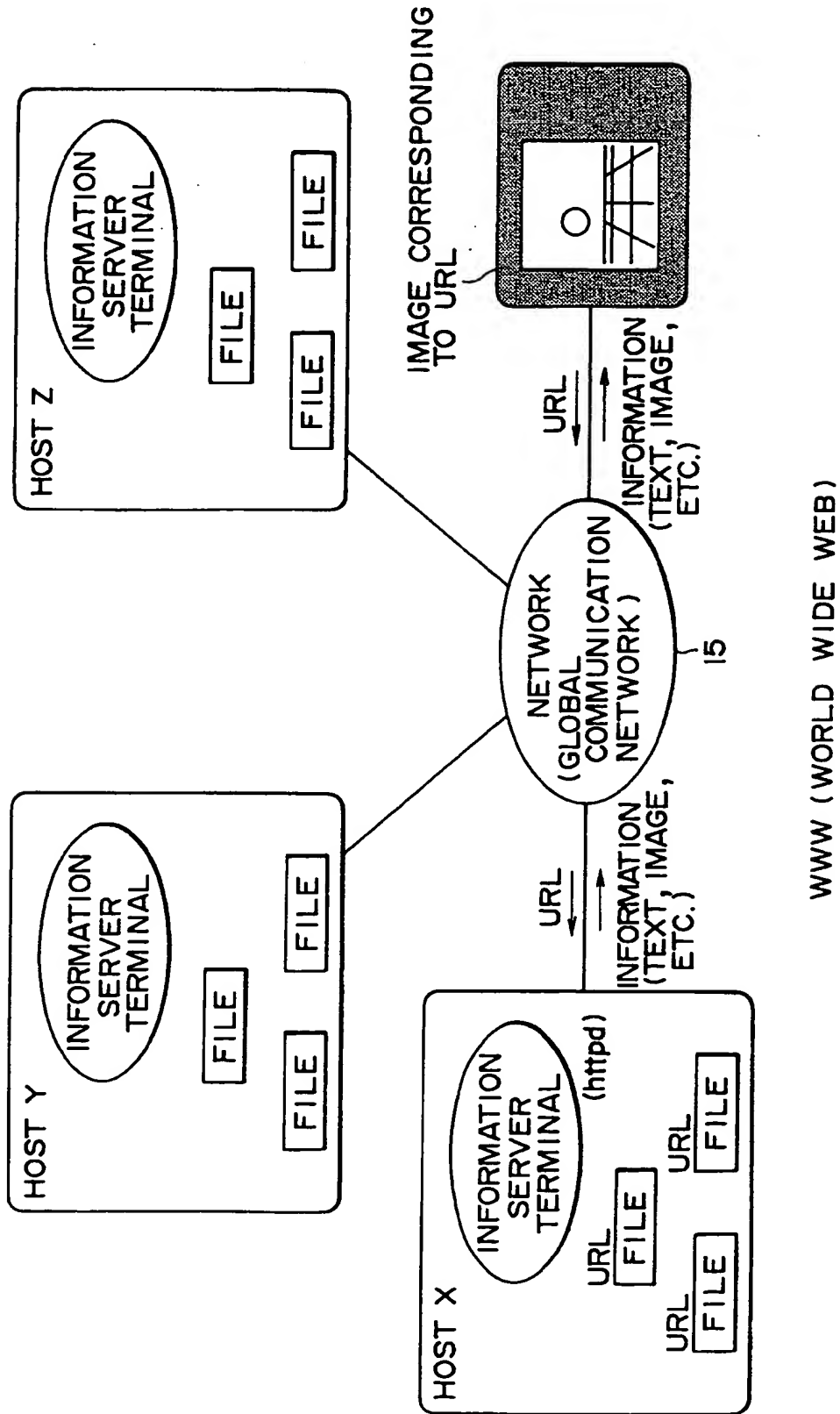


FIG. 3

PROTOCOL TYPE  
 http : // www. csl. sony. co. jp / index. html  
 HOST NAME FILE NAME

FIG. 4

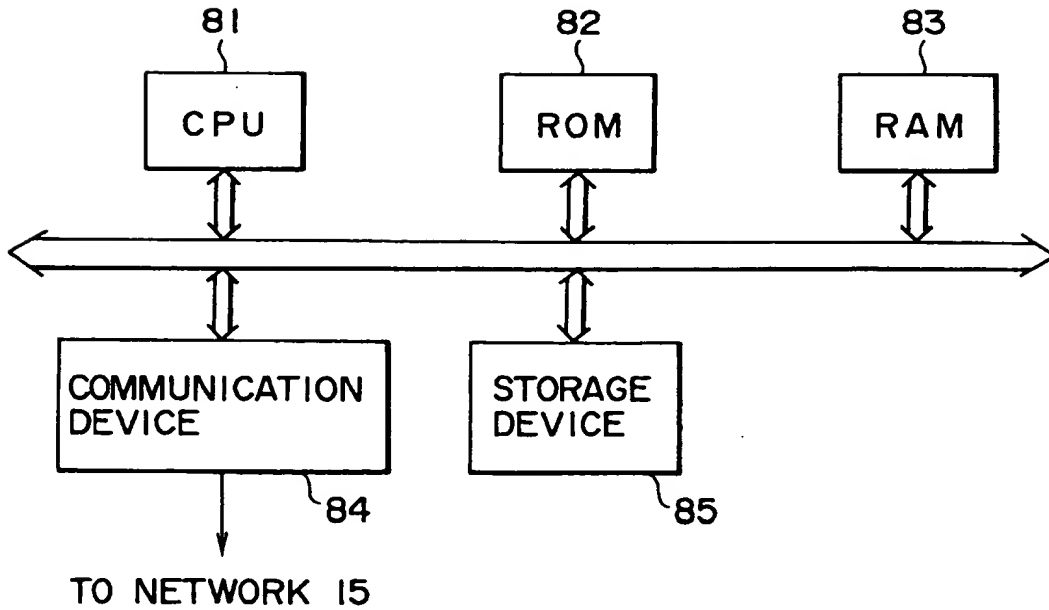
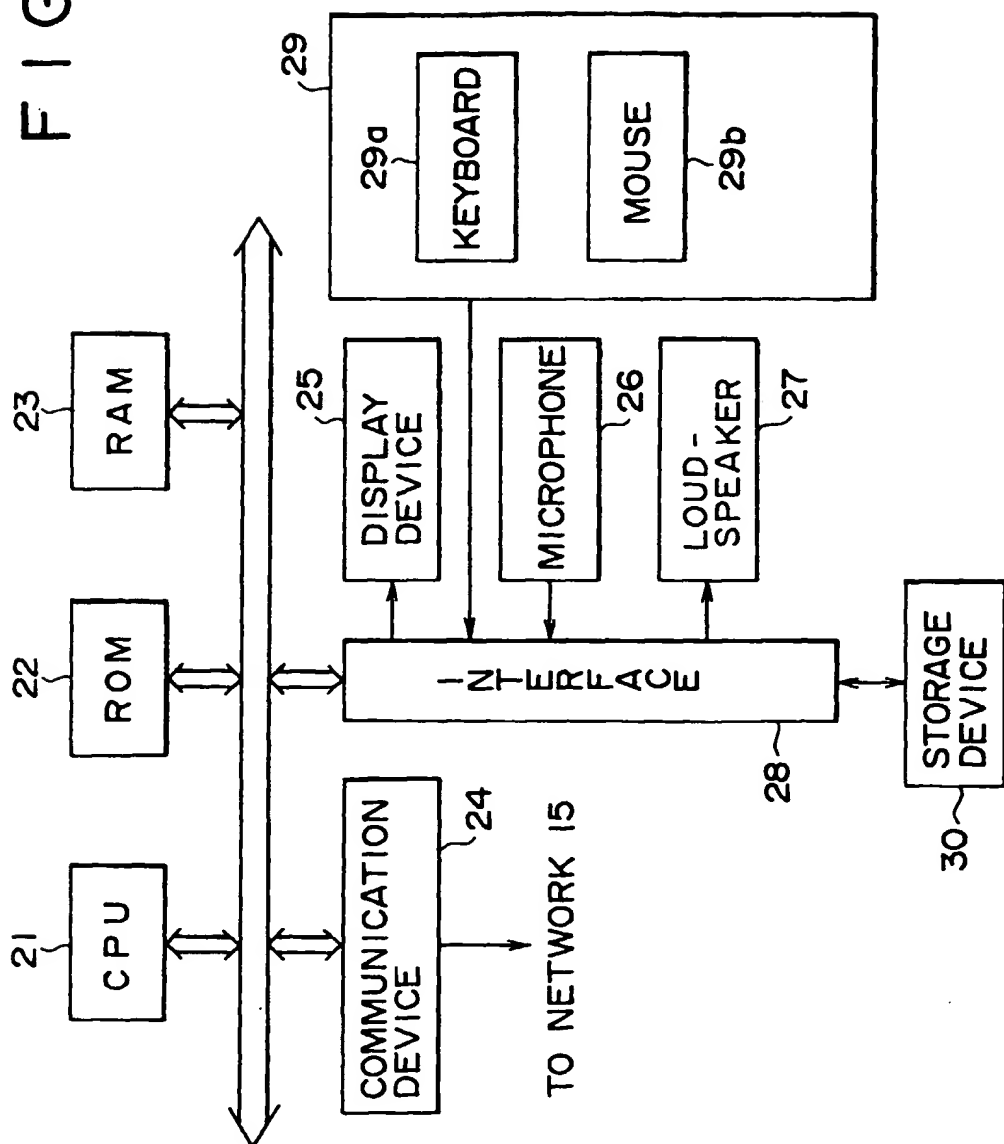


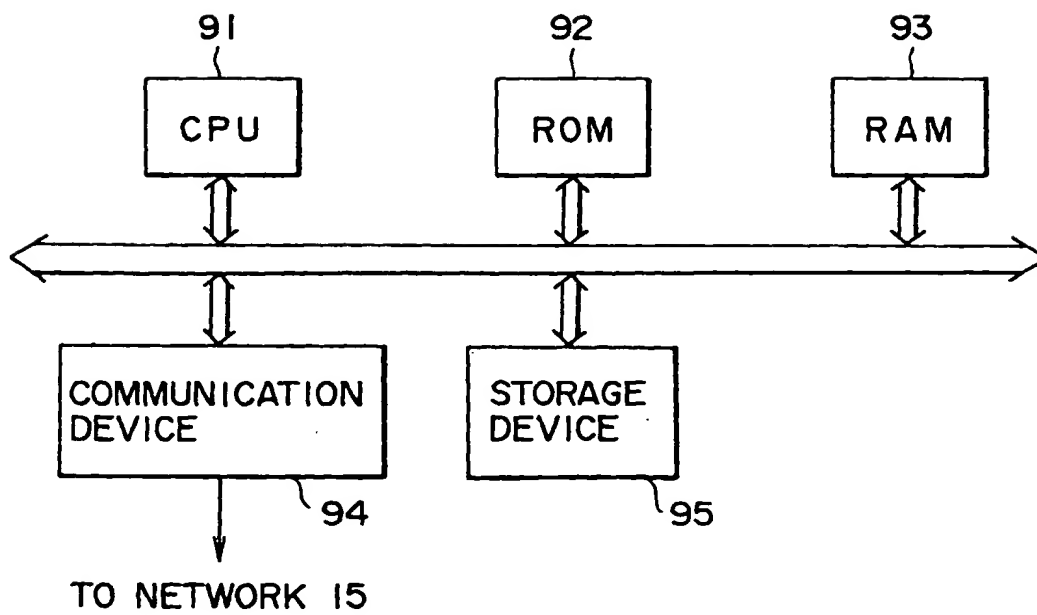
FIG. 5



11



FIG. 6



12

FIG. 7

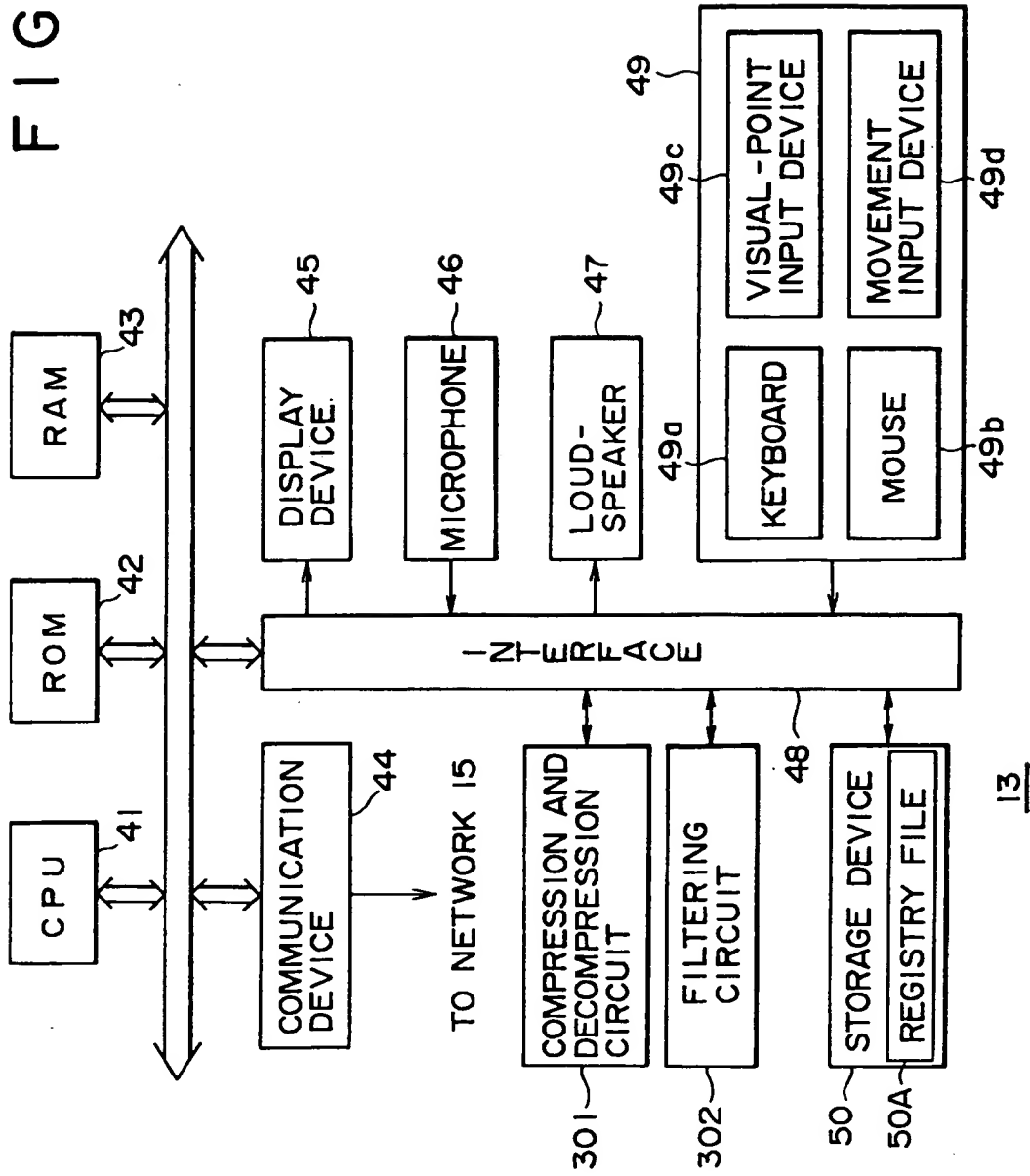


FIG. 8

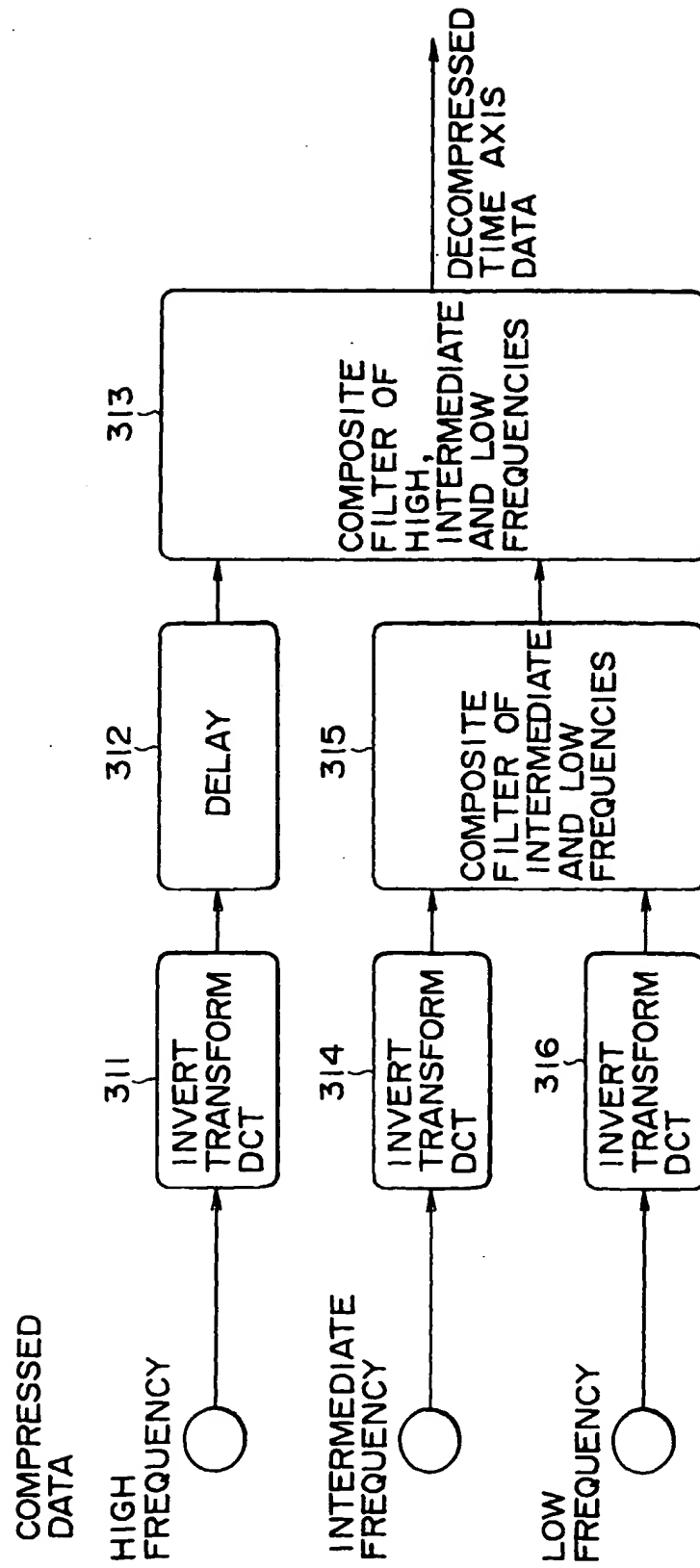


FIG. 9

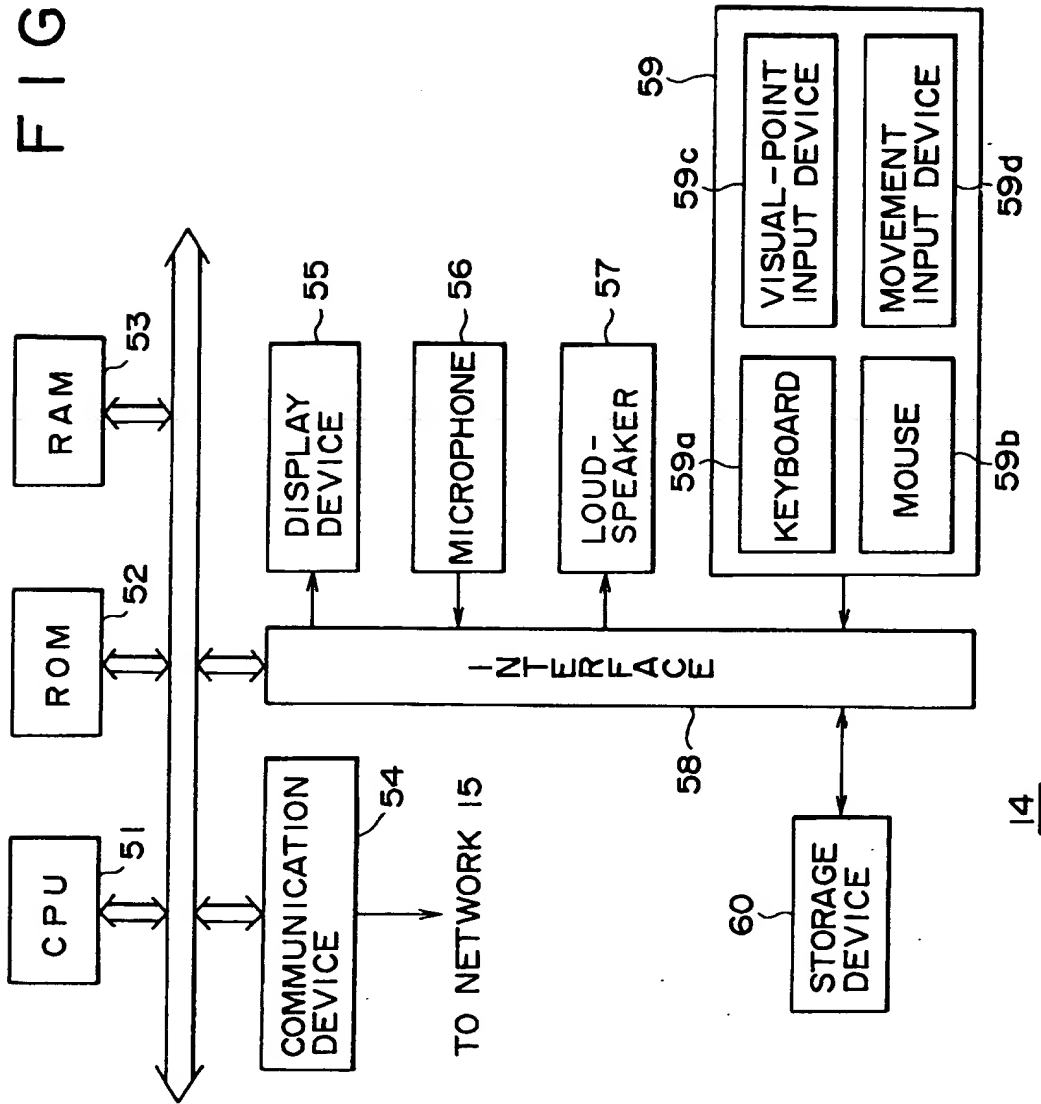
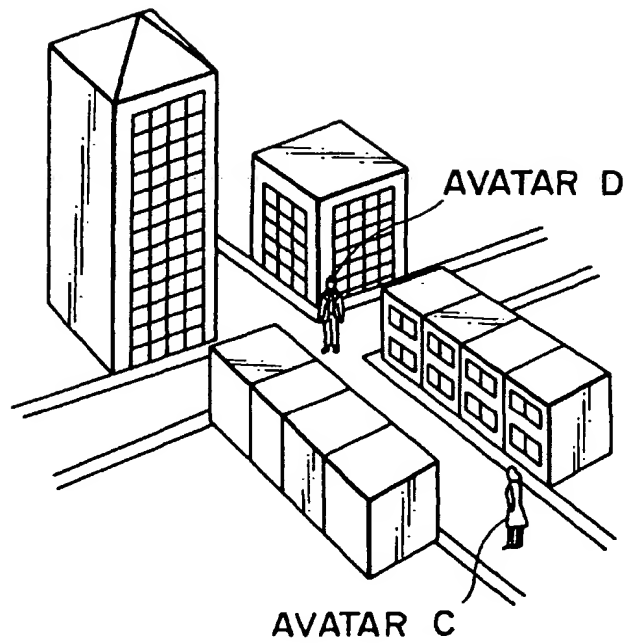
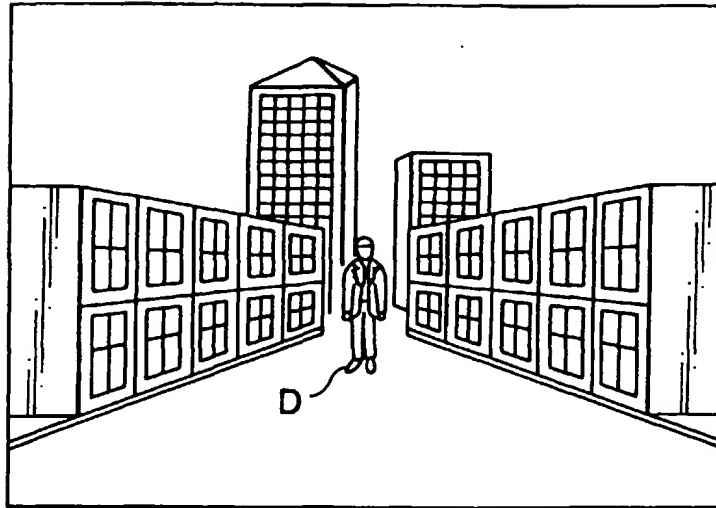


FIG. 10



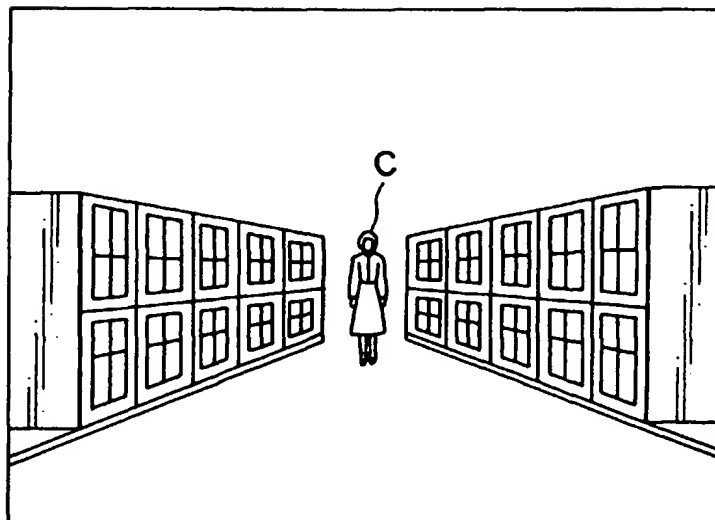
VIRTUAL WORLD MODEL

FIG. 11



VIEWPOINT FROM AVATAR C

FIG. 12



VIEWPOINT FROM AVATAR D

FIG. 13

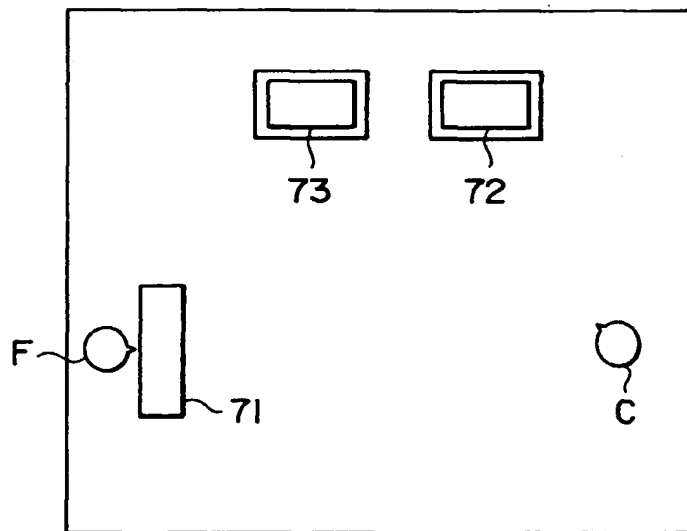


FIG. 14

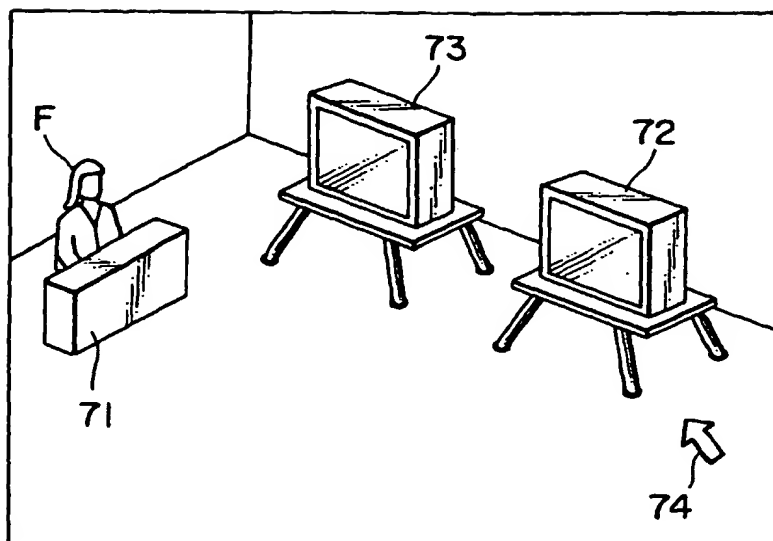


IMAGE VIEWED FROM CLIENT



FIG. 15

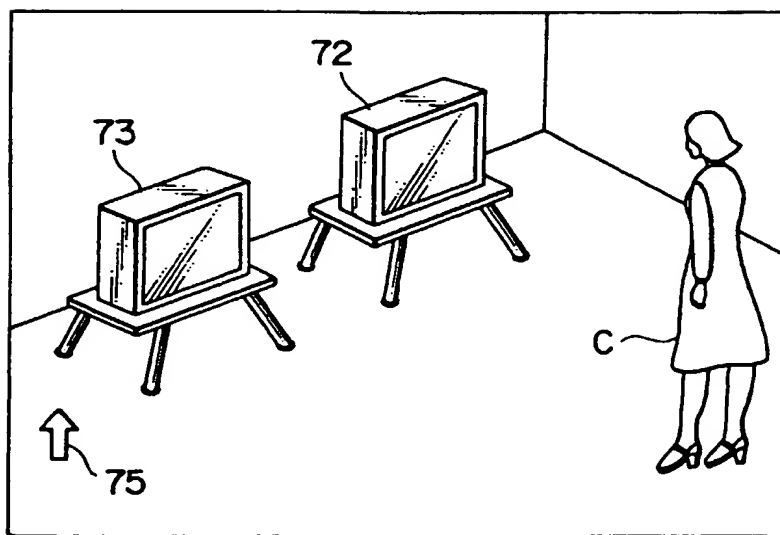


IMAGE VIEWED FROM COUNTER

FIG. 16

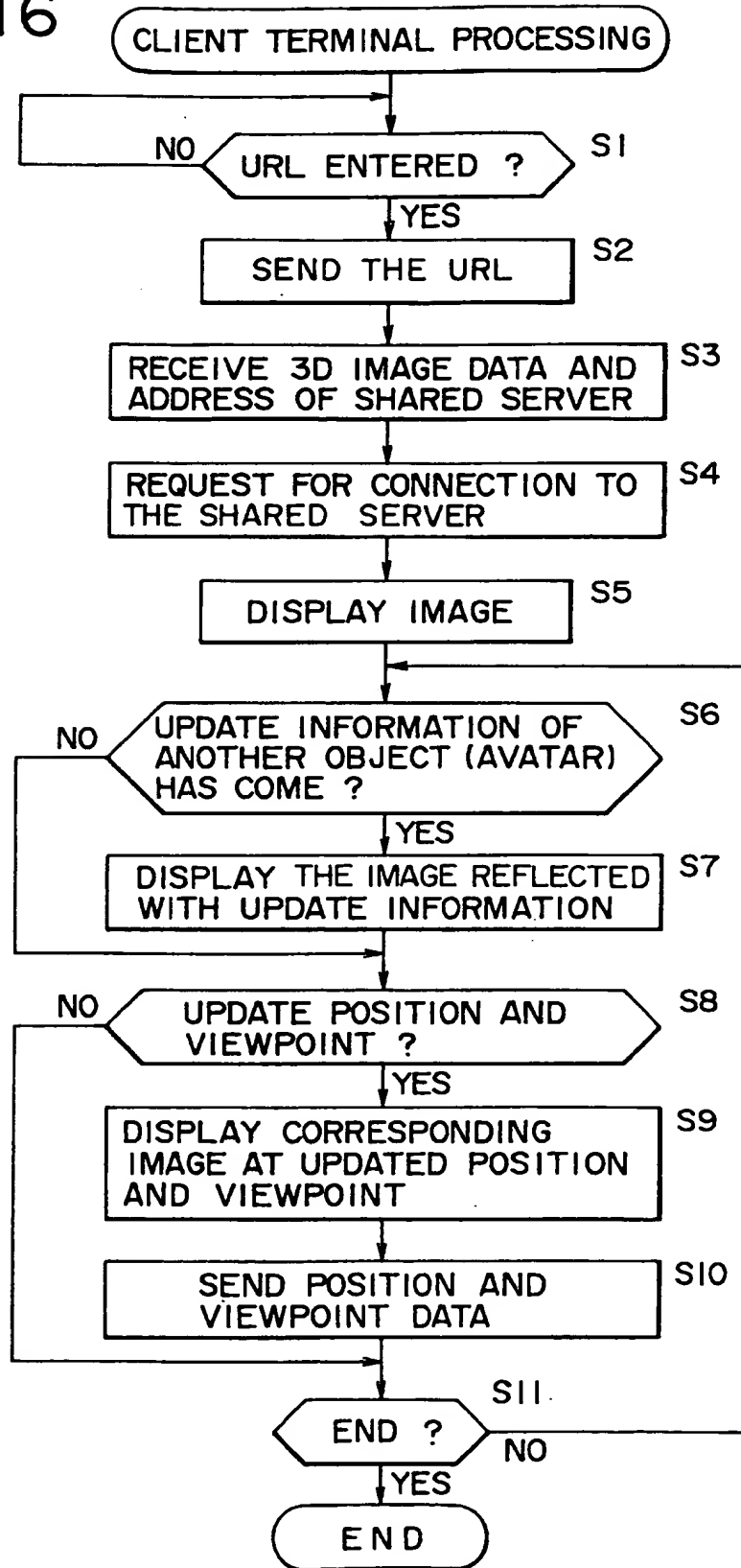


FIG. 17

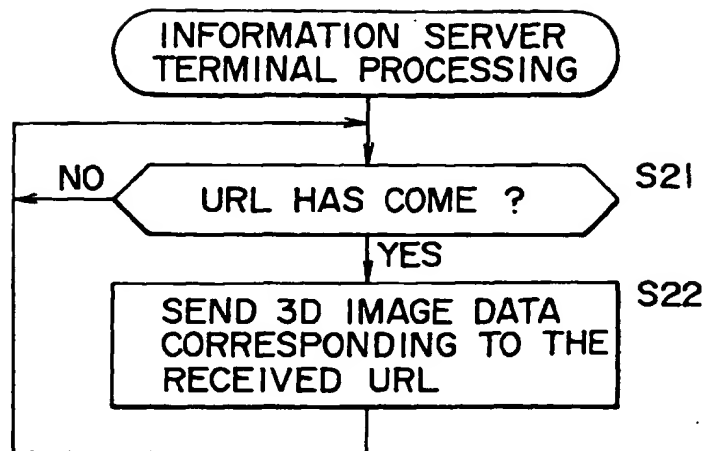


FIG. 18

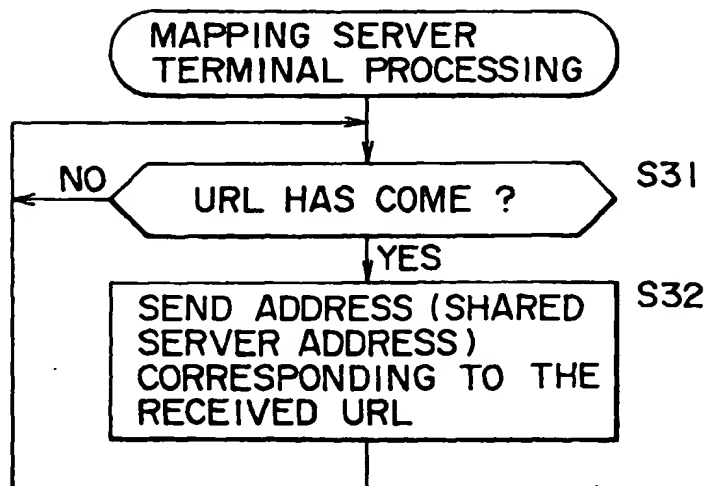
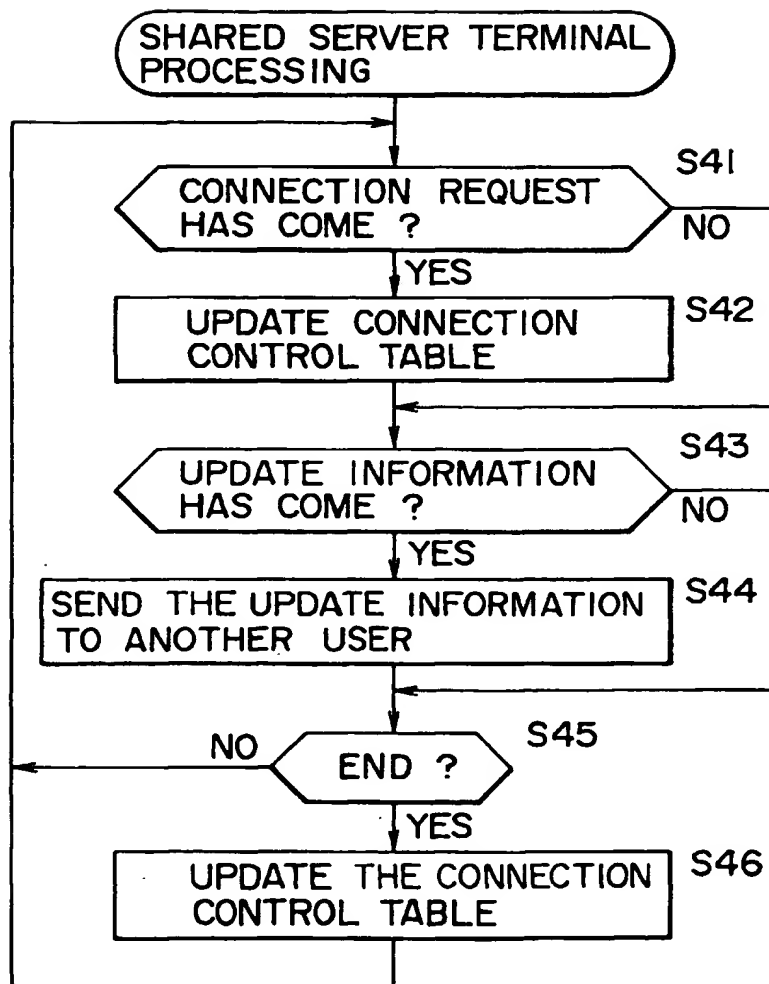


FIG. 19



## FIG. 20

COMMUNICATION PROTOCOL FOR THE CASE IN WHICH  
SHARED SPACE SERVER IS CONSTRUCTED ON WWW

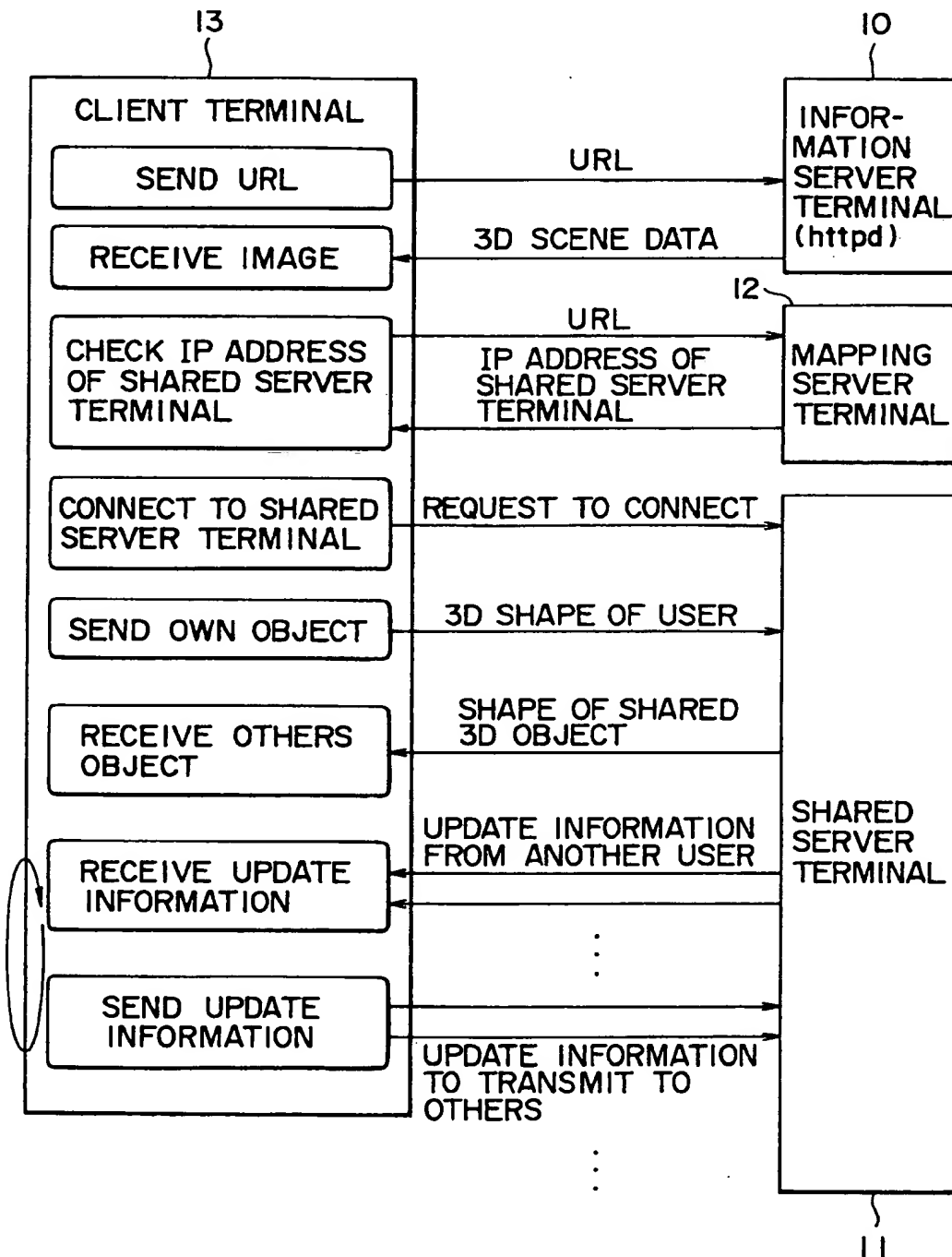


FIG. 21

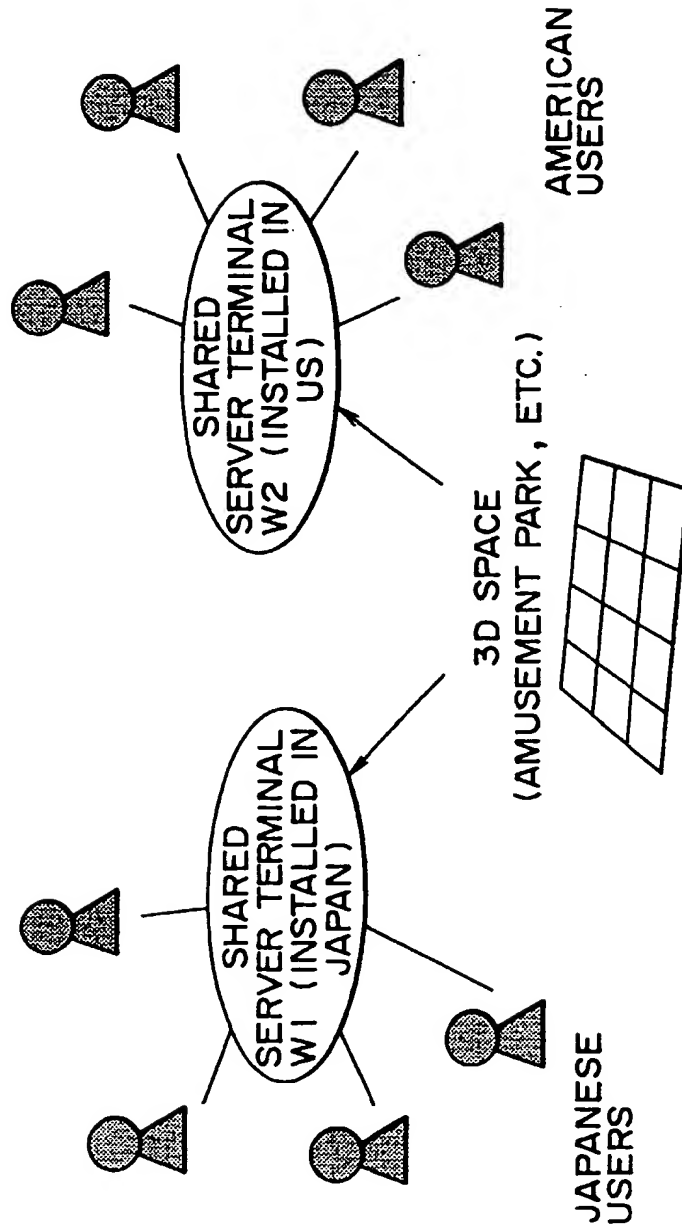


FIG. 22

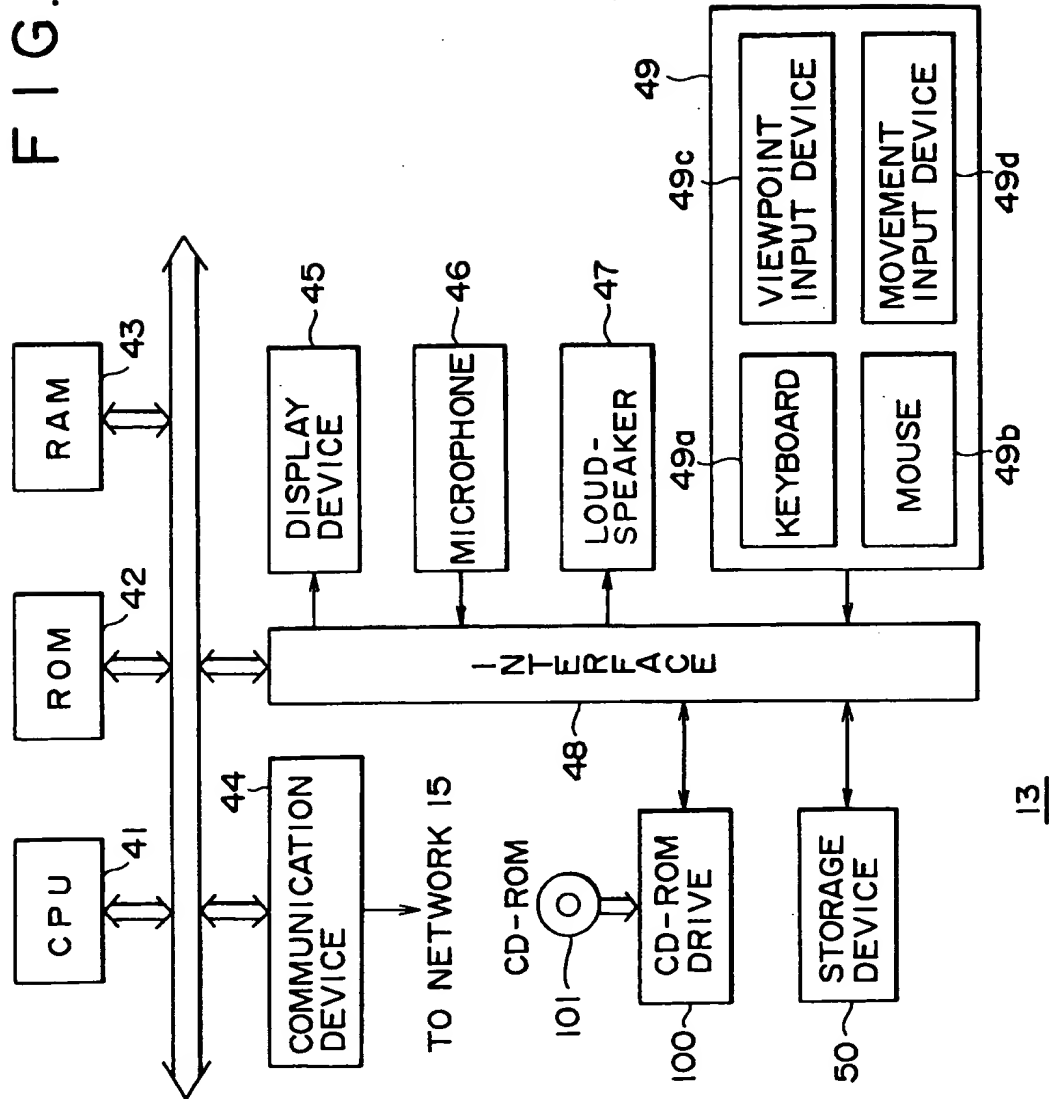
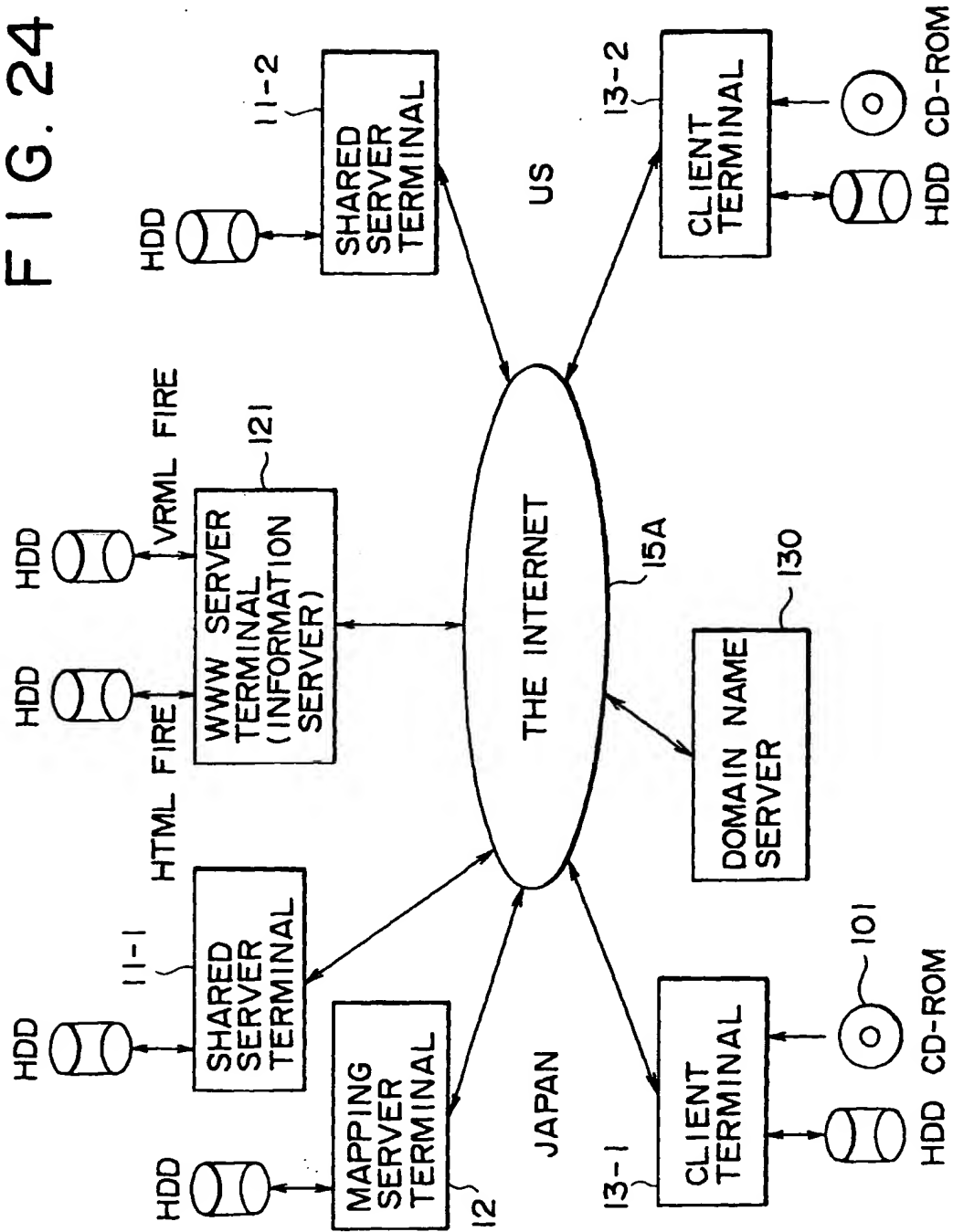


FIG. 23

CASE	BASIC OBJECT DATA STORED IN :	URL OF UPDATE OBJECT DATA STORED IN :	UPDATE OBJECT DATA STORED IN :
1	VRML FILE OF SPECIFIC DIRECTORY IN STORAGE DEVICE OF INFORMATION SERVER	DEFAULT URL	INFORMATION SERVER
2		MAPPING SERVER	SHARED SERVER IN JAPAN
3			SHARED SERVER IN US
4	VRML FILE OF SPECIFIC DIRECTORY IN STORAGE DEVICE OF CLIENT TERMINAL	MANUALLY SPECIFY URL	SPECIFIED SHARED SERVER
5		MAPPING SERVER	SHARED SERVER IN JAPAN
6			SHARED SERVER IN US
7	VRML FILE OF SPECIFIC DIRECTORY OF CD-ROM OF CLIENT TERMINAL	MANUALLY SPECIFY URL	SPECIFIED SHARED SERVER
8		MAPPING SERVER	SHARED SERVER IN JAPAN
9			SHARED SERVER IN US



FIG. 24



F1G.25

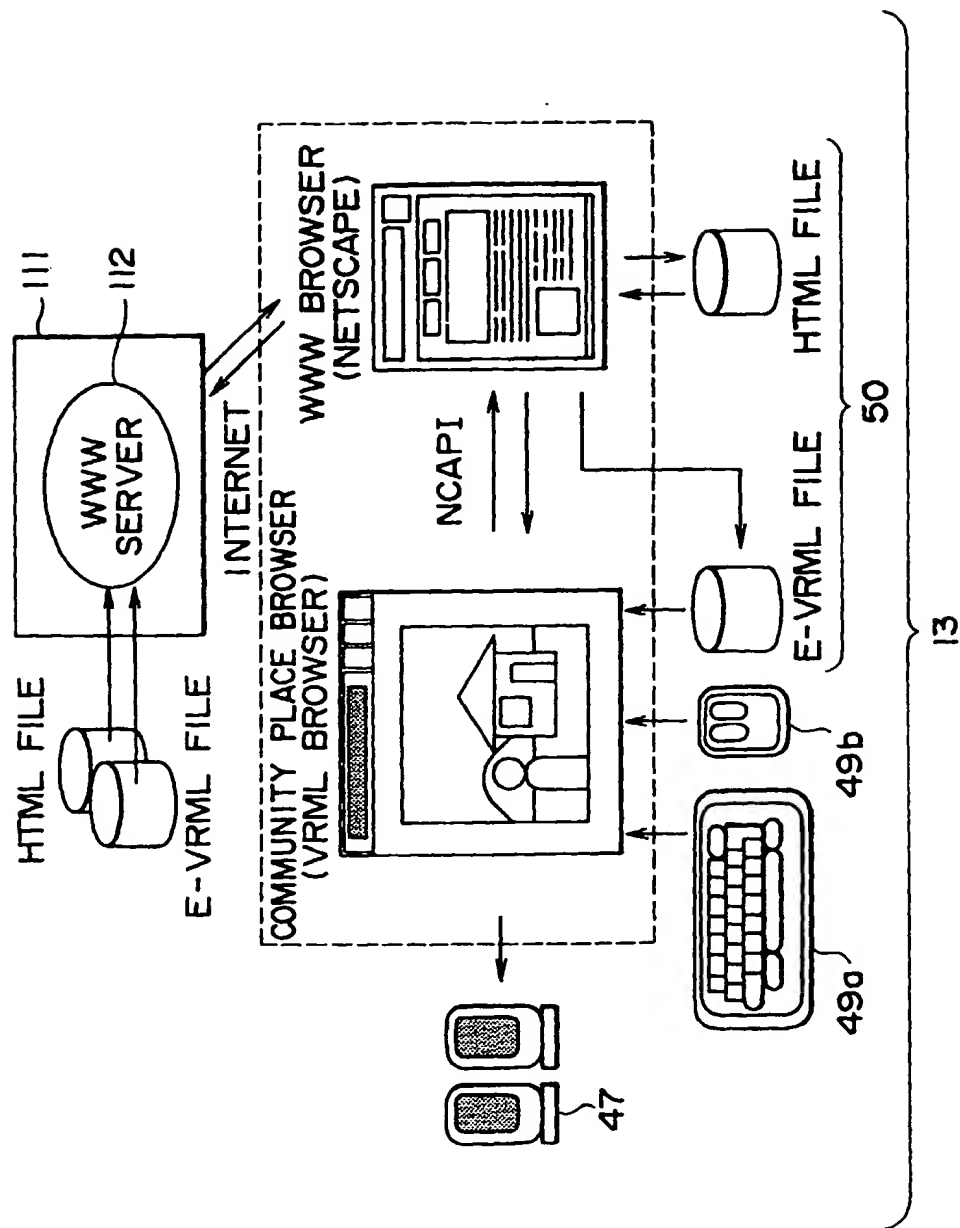


FIG. 26

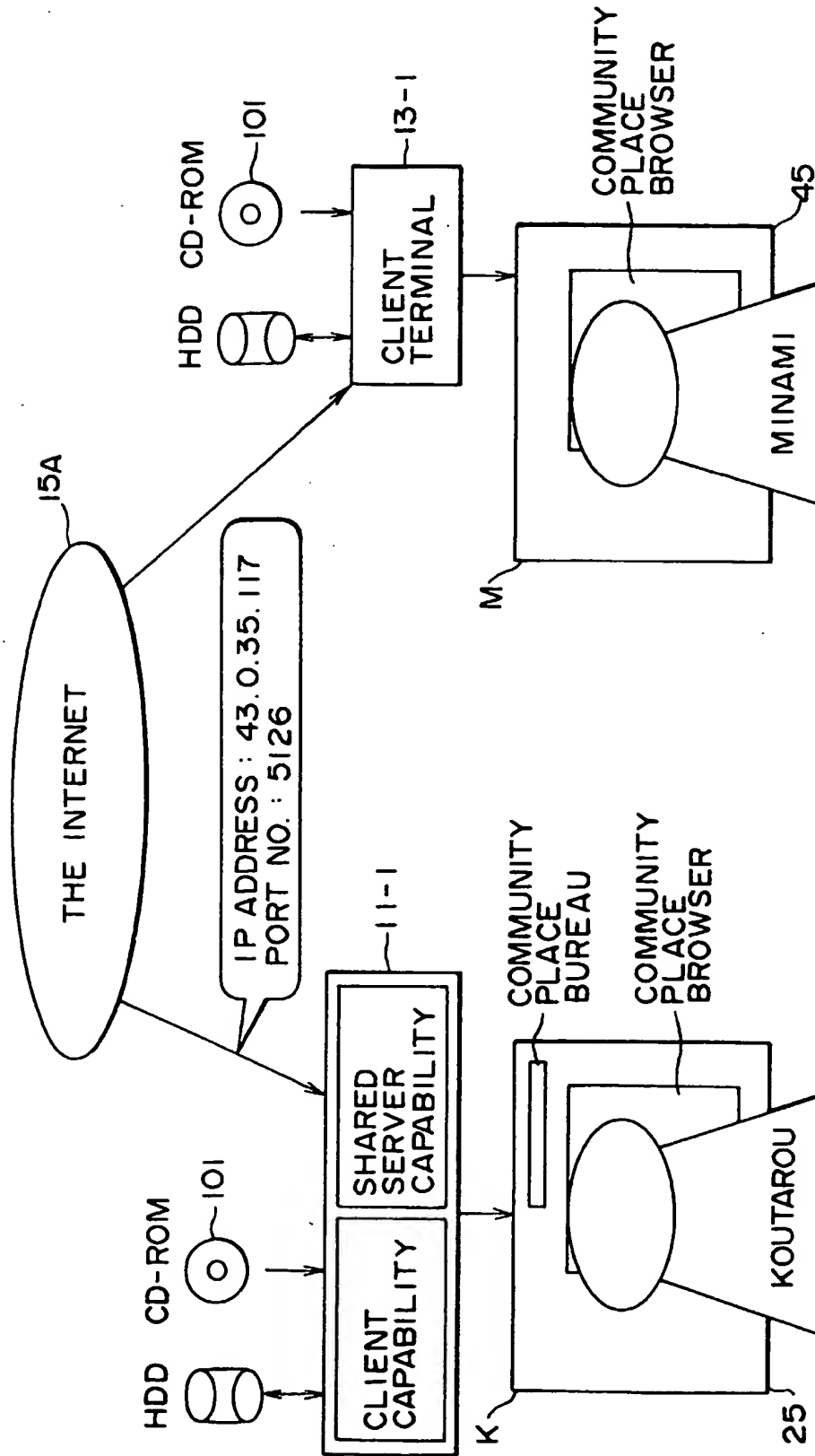


FIG. 27

	MINIMUM OPERATING ENVIRONMENT	RECOMMENDED OPERATING ENVIRONMENT
HARDWARE	PC ON WHICH WINDOWS 95/NT OPERATE	→ PENTIUM 75MHz OR HIGHER
CPU	486D x 2, 66MHz	→ 32MB OR HIGHER
MEMORY	12MB	→ 800 x 600 PIXELS OR HIGHER
DISK FREE SPACE	3MB (9MB AT INSTALLATION) OR HIGHER	→ 65536 COLORS OR HIGHER
RESOLUTION	640 x 480 PIXELS	→ SOUND BOARD
DISPLAY COLORS	256 COLORS	
SOFTWARE	NETSCAPE NAVIGATOR FOR WINDOWS (VER 2.0 OR LATER)	
SOUND		

FIG. 28

USER ID	SHARED DATA				
	NICKNAME	AVATAR PARAMETERS	SHARED SPACE COORDINATES		
			x	y	z
01					
02					
03					
04					
05					
06					
07					
08					
09					
10					
⋮					
63					
64					

FIG. 30

USER ID	SHARED DATA				
	NICKNAME	AVATAR PARAMETERS	SHARED SPACE COORDINATES		
			x	y	z
02					
03					
04					
05					
06					
07					
08					
09					
10					
11					

# FIG. 29

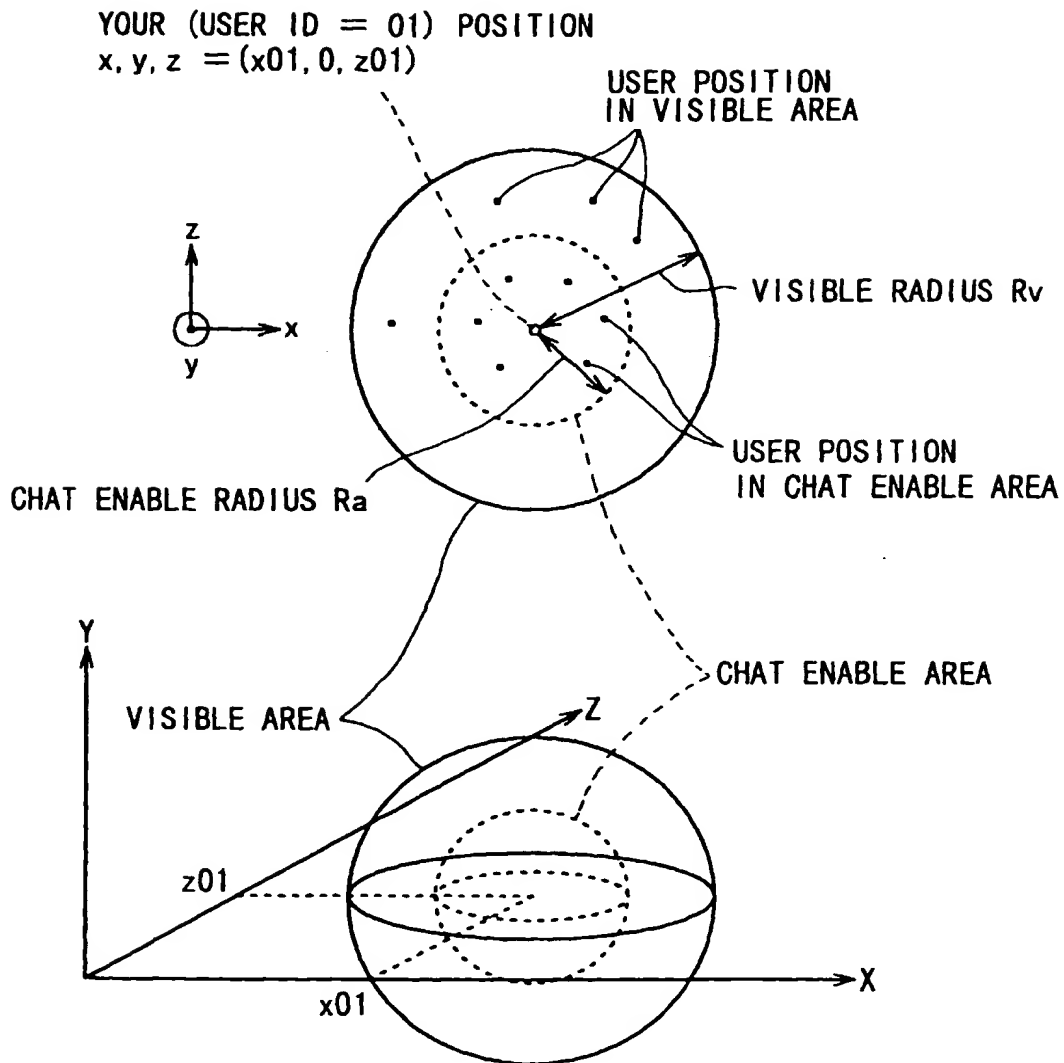


FIG. 31

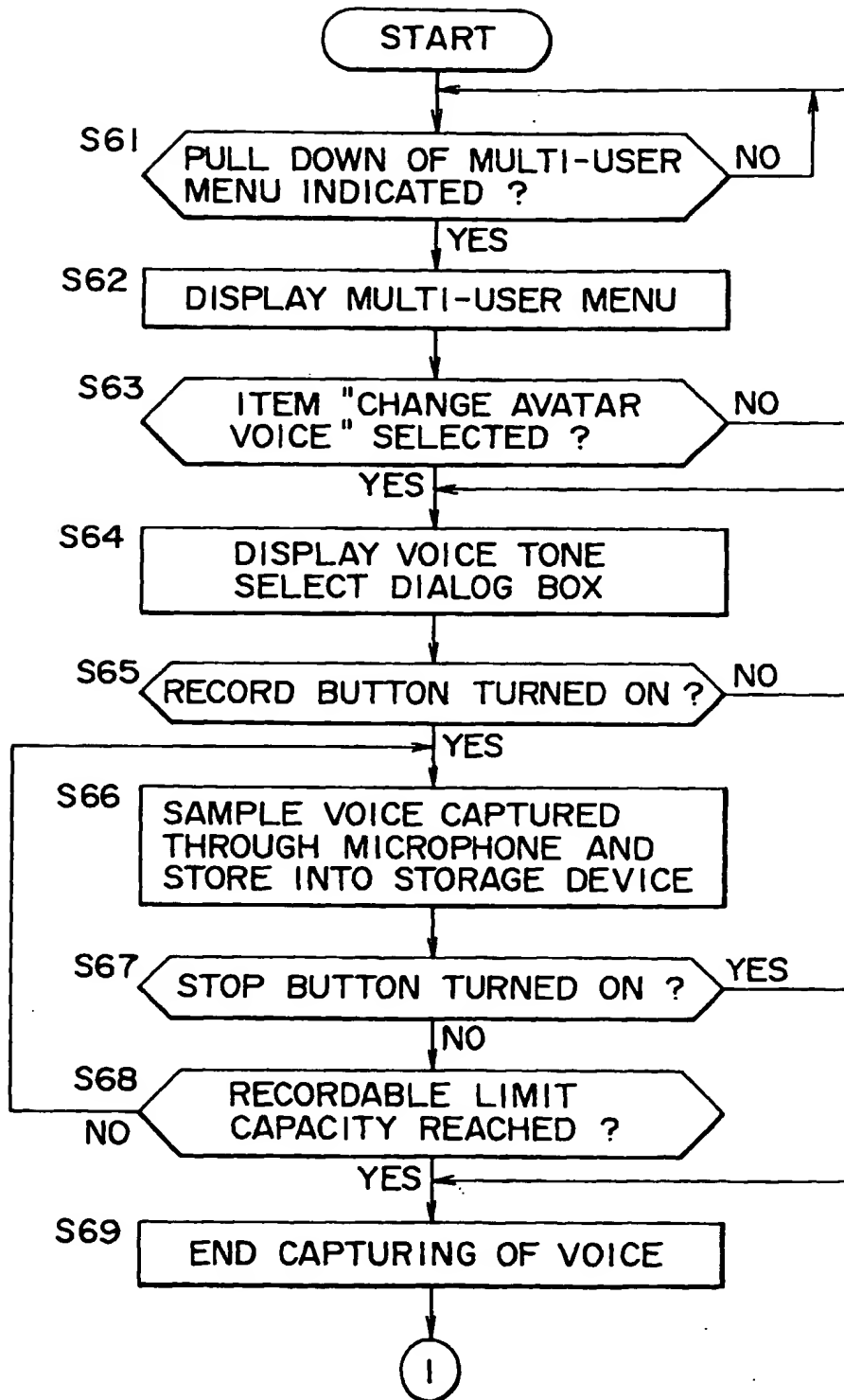


FIG. 32

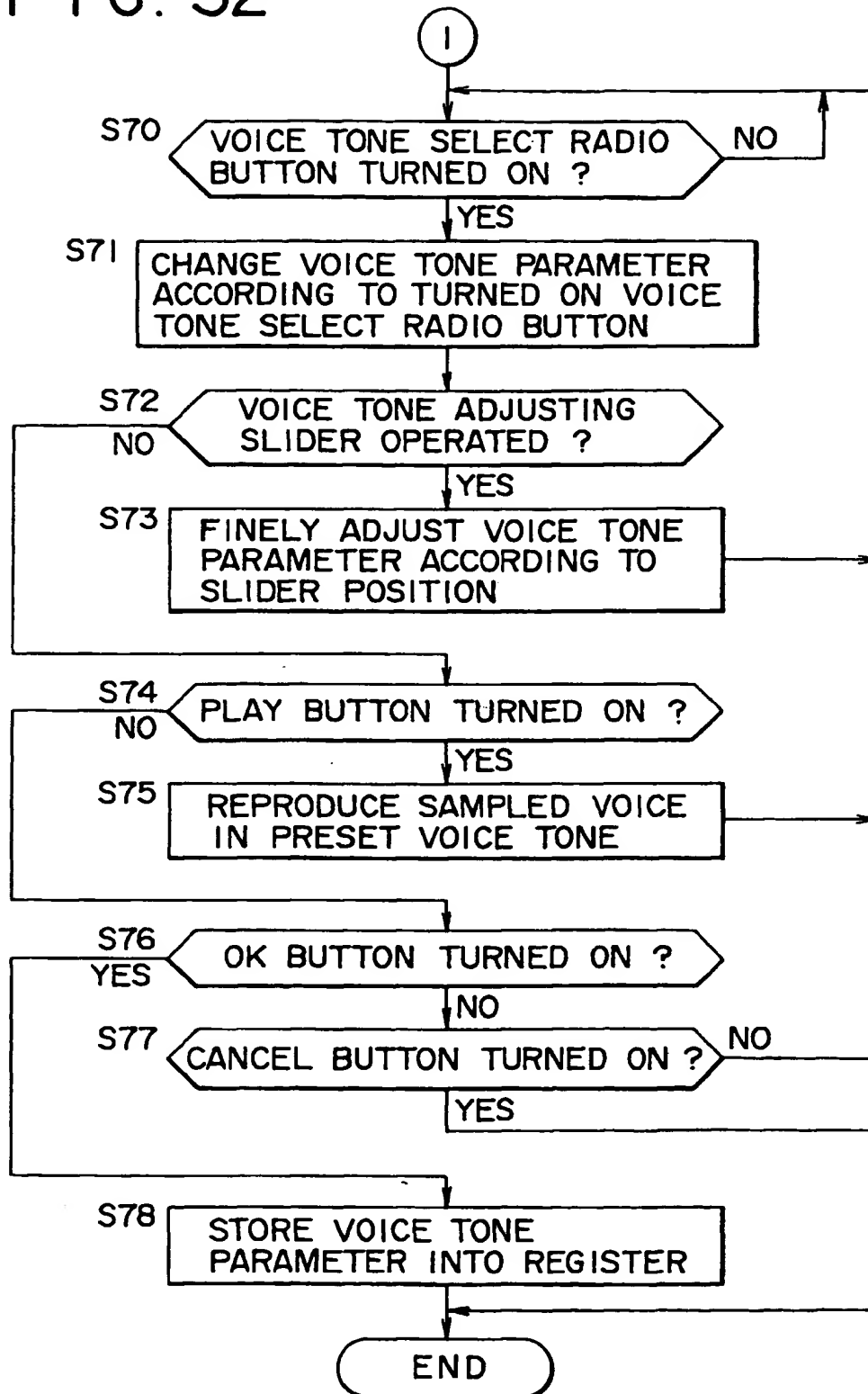
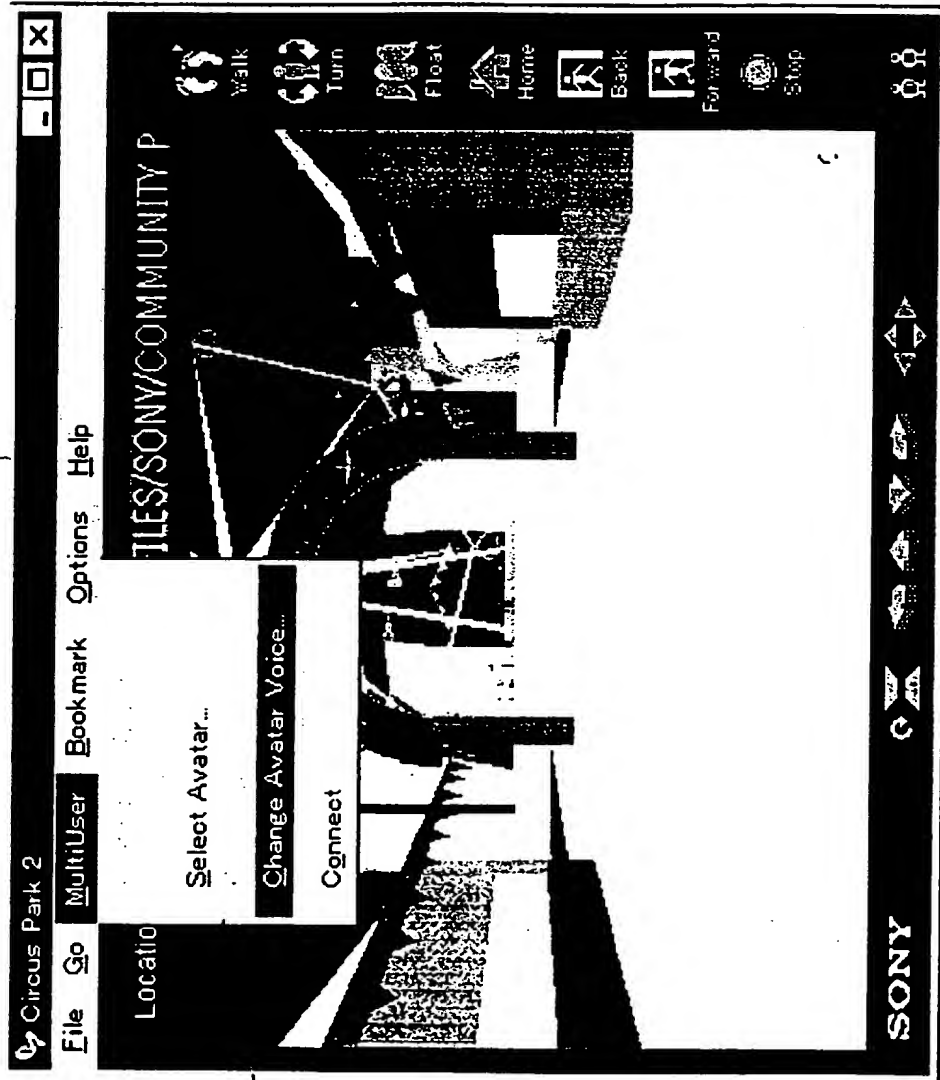




FIG. 33

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FIG. 34

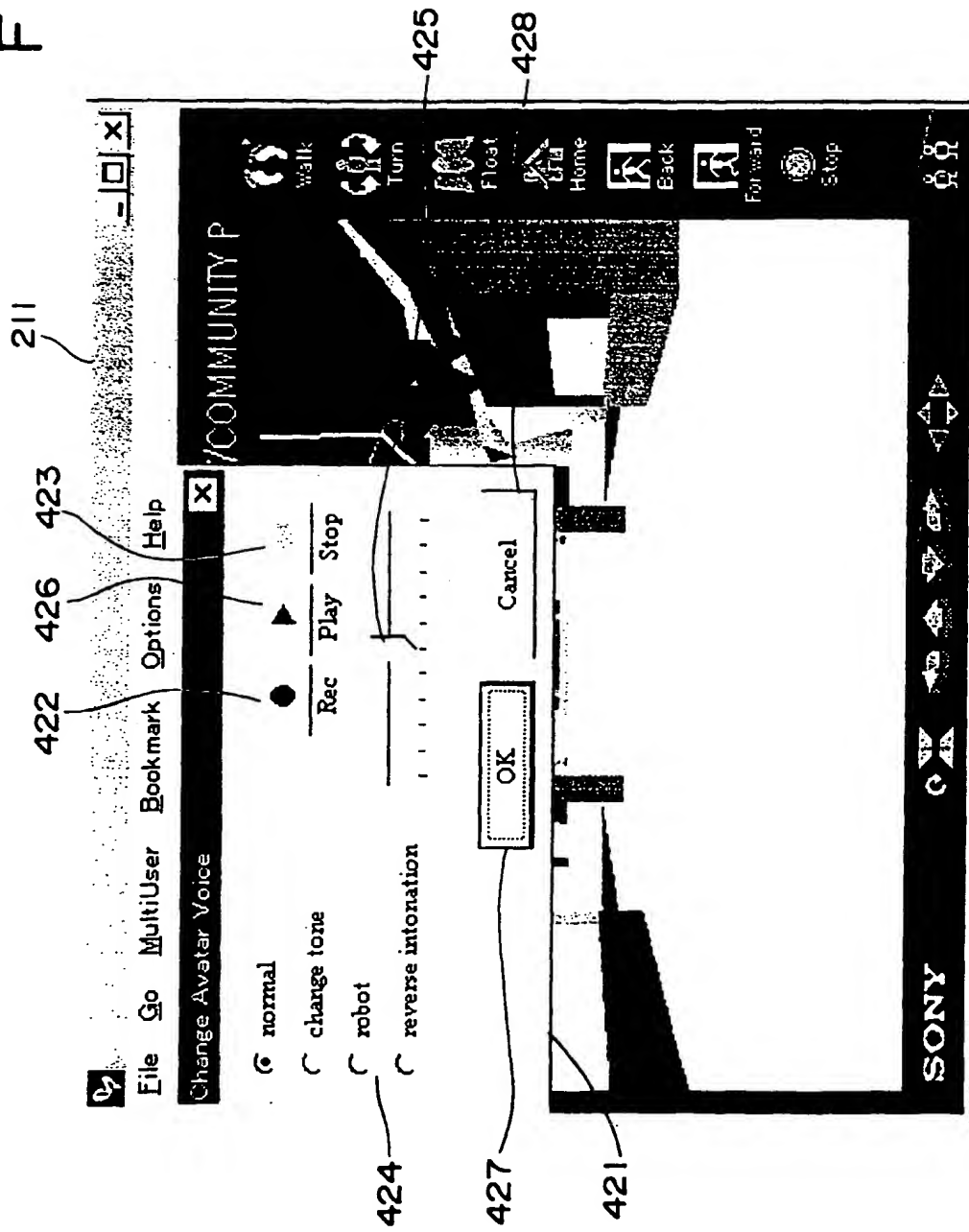


FIG. 35

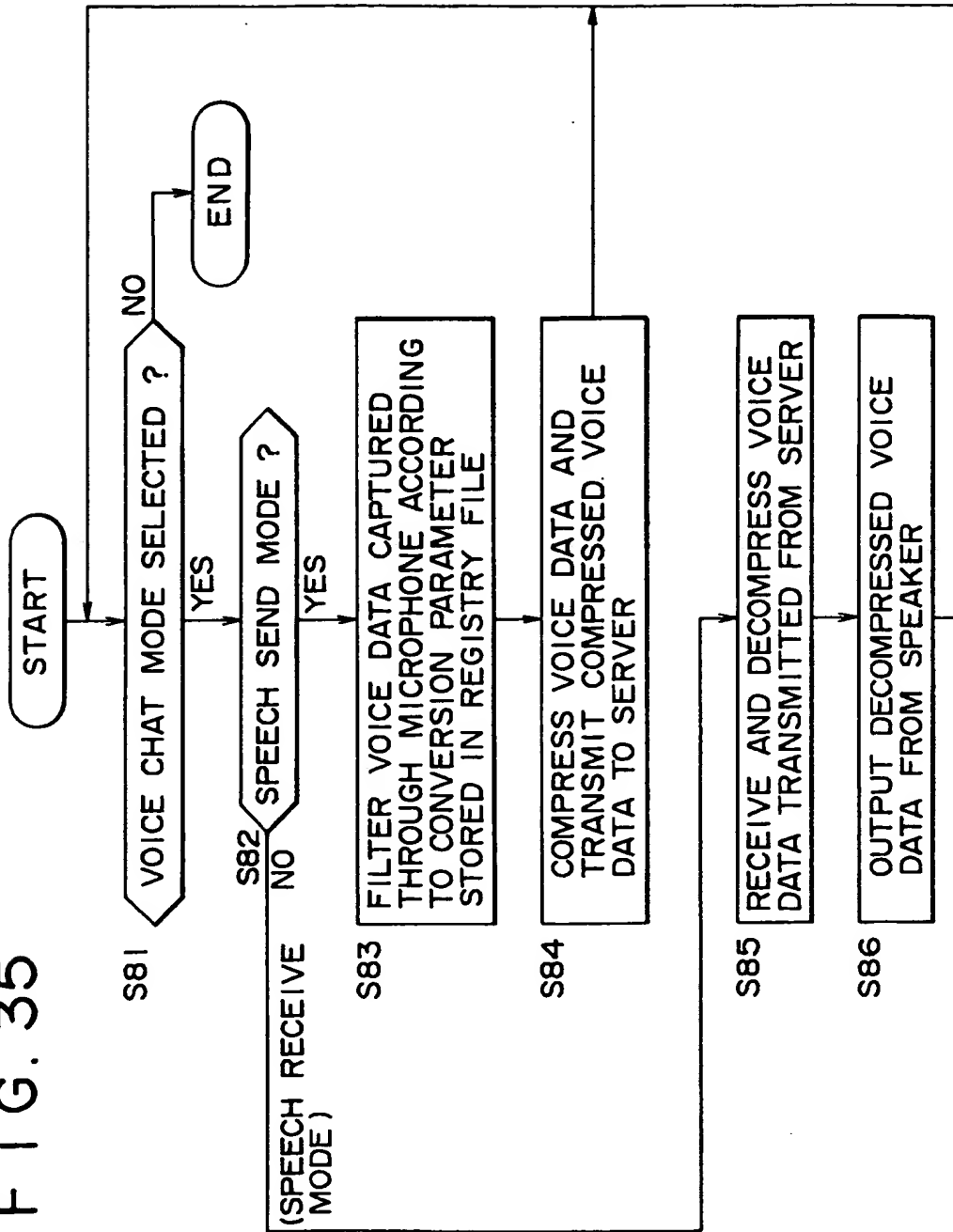


FIG. 36

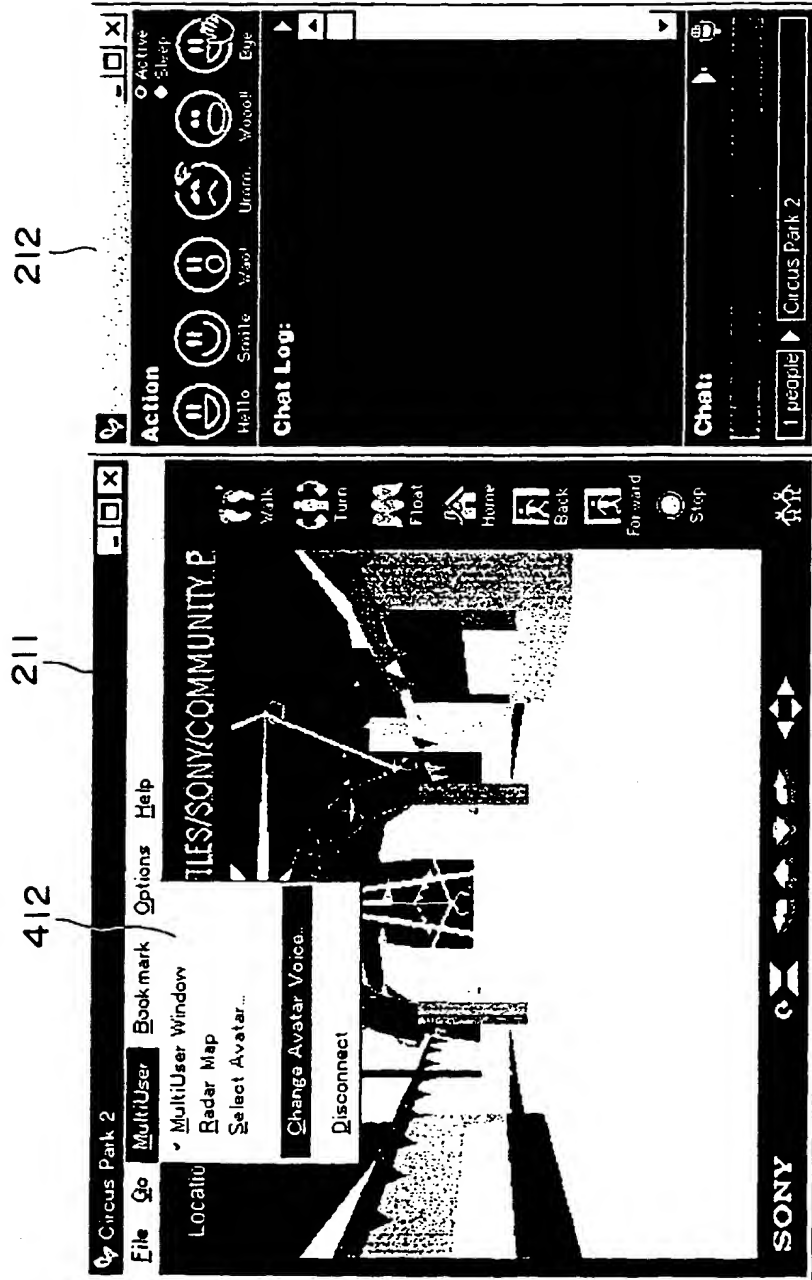


FIG. 37

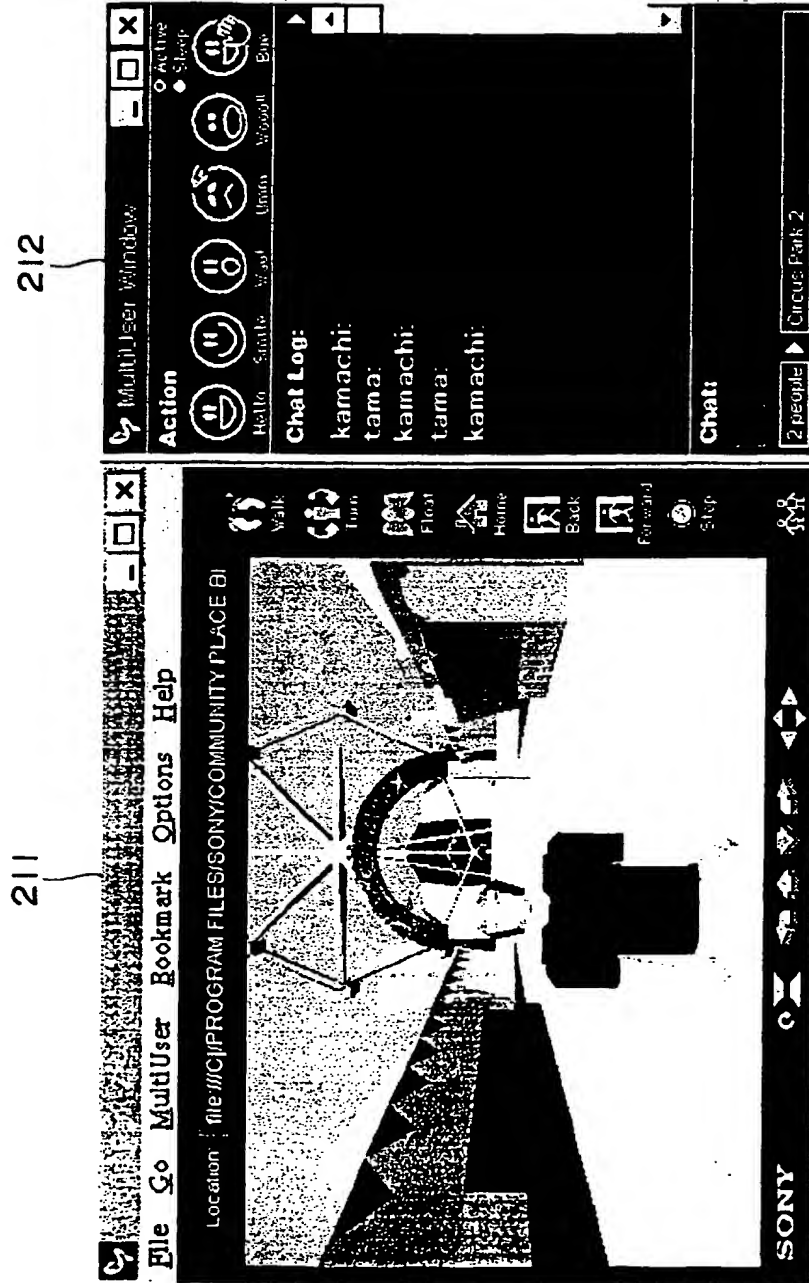


FIG. 38

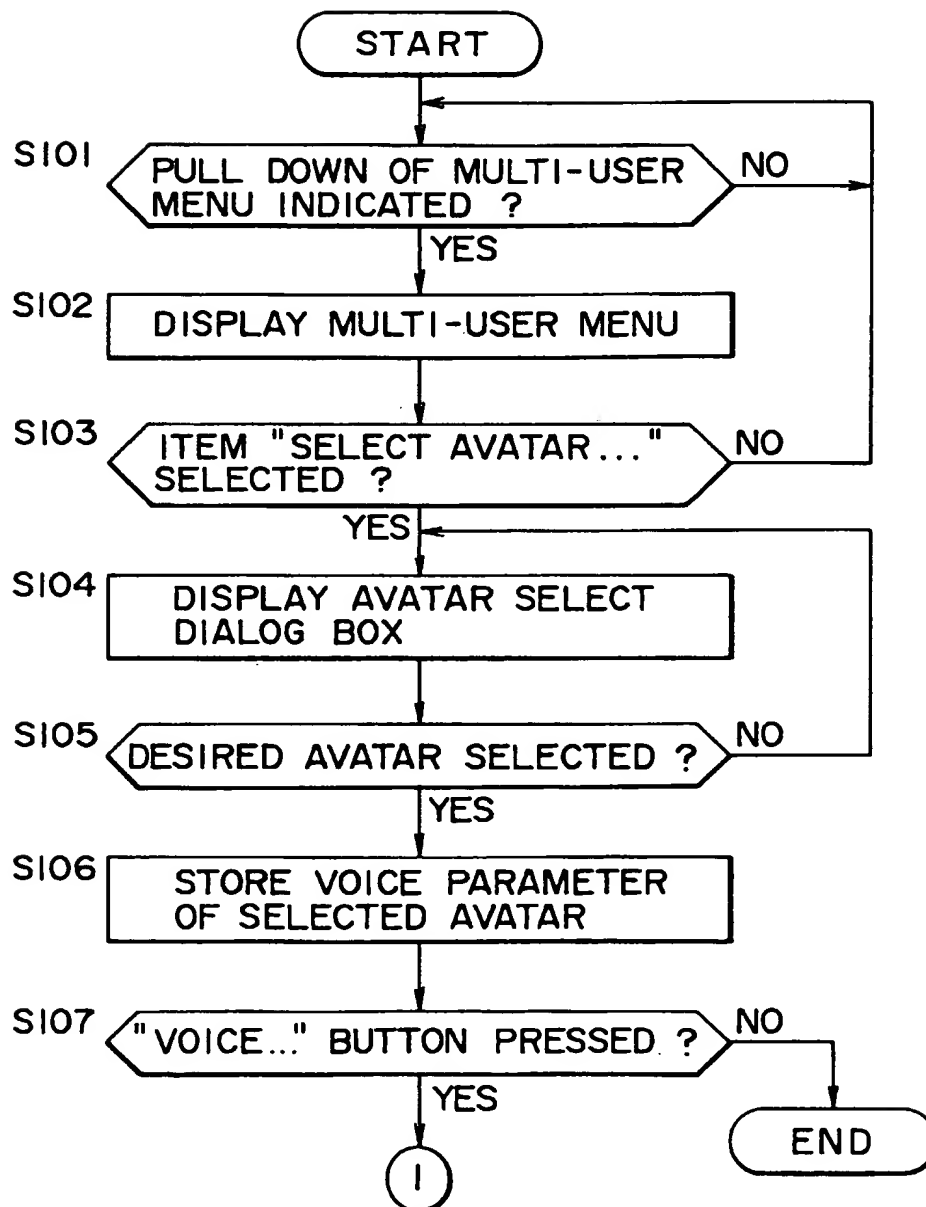


FIG. 39

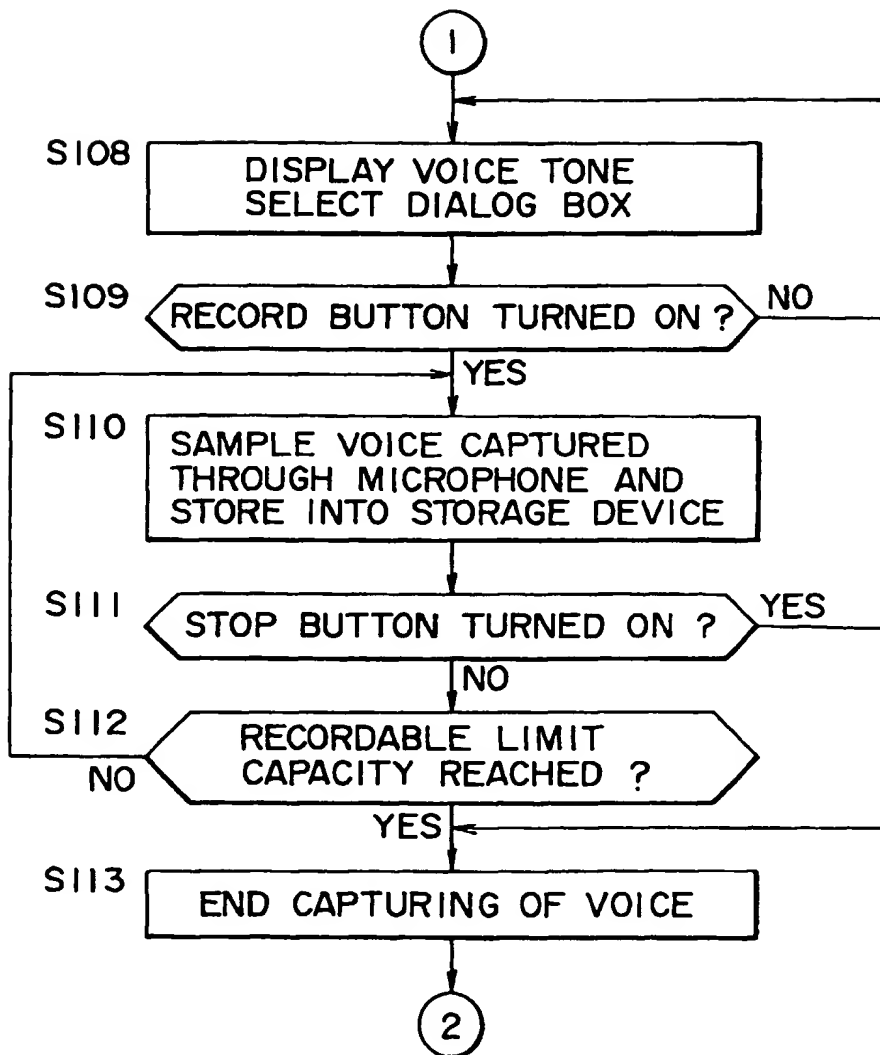


FIG. 40

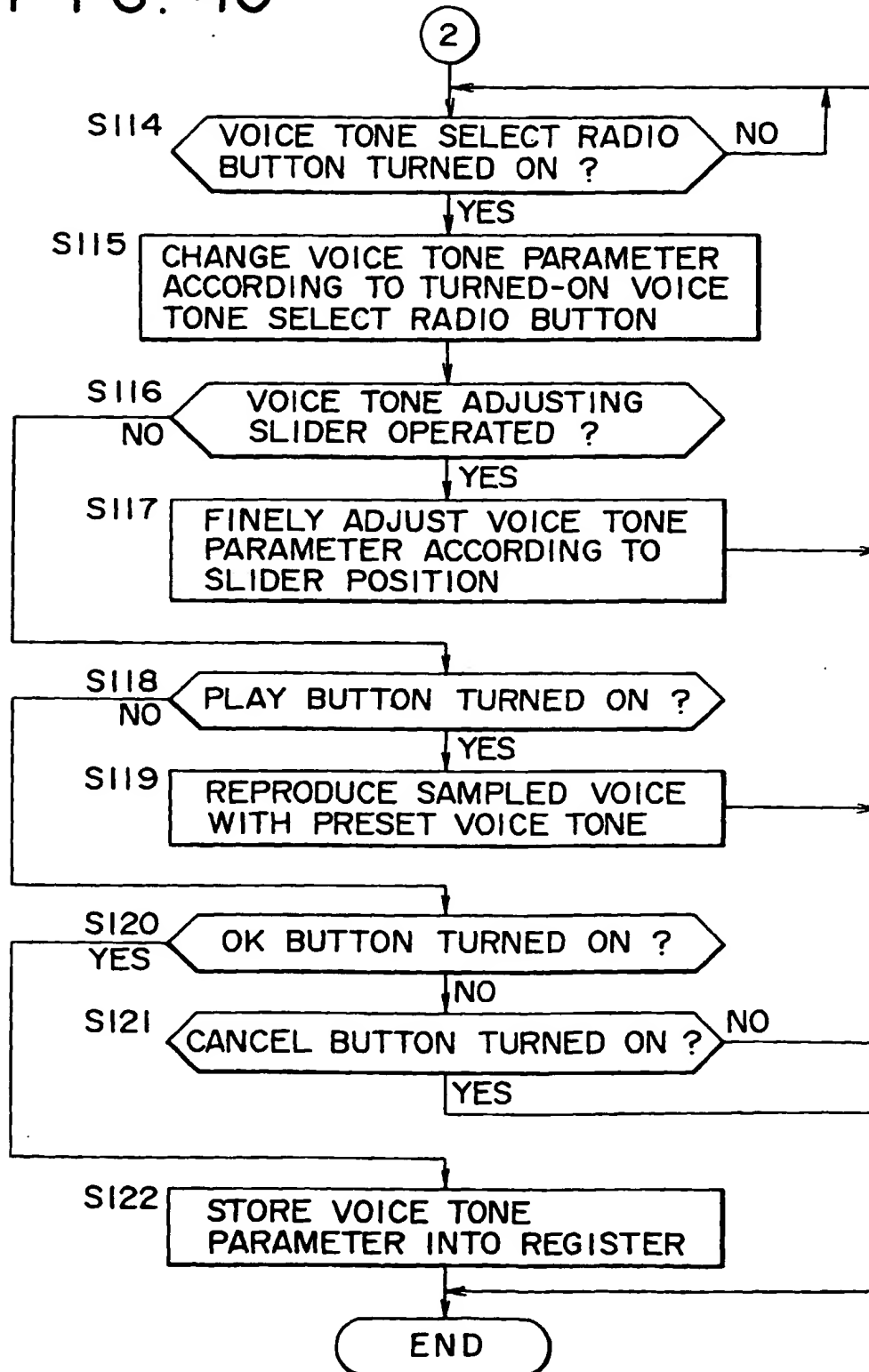
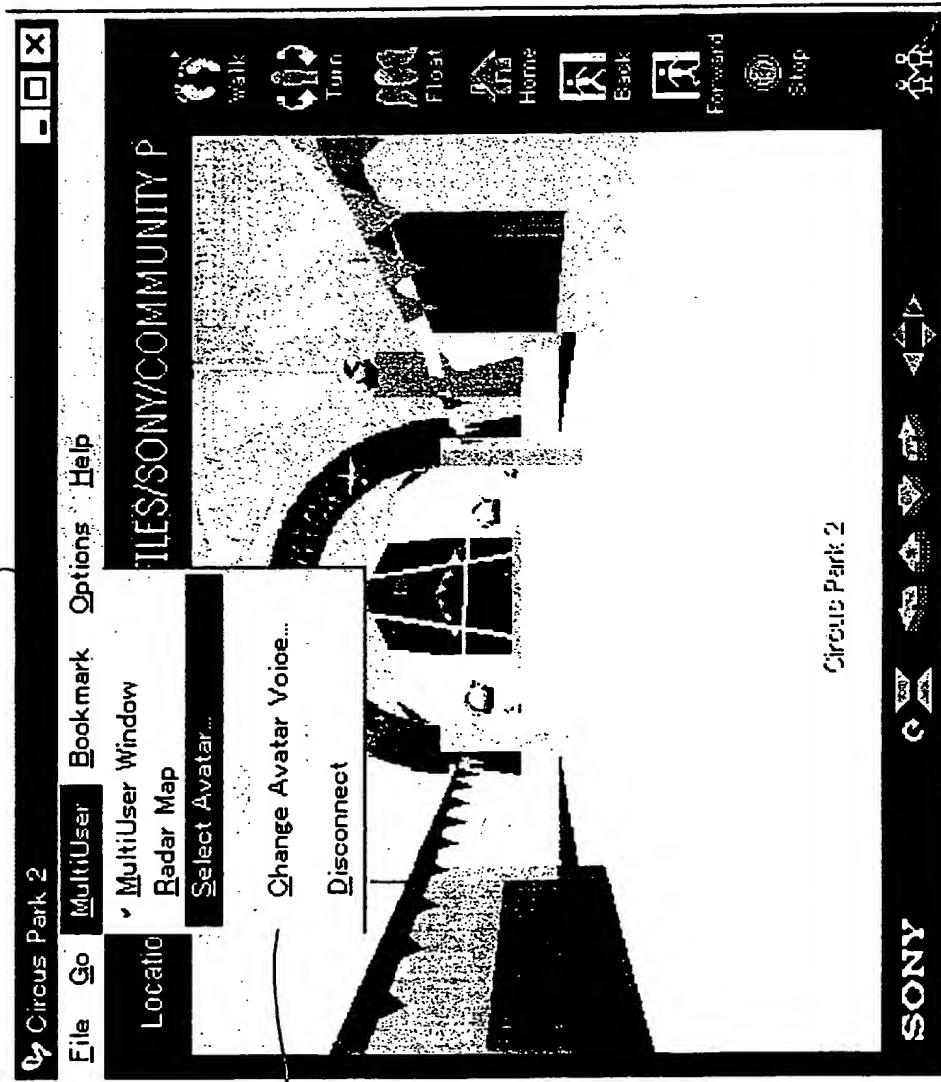




FIG. 41

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FIG. 42

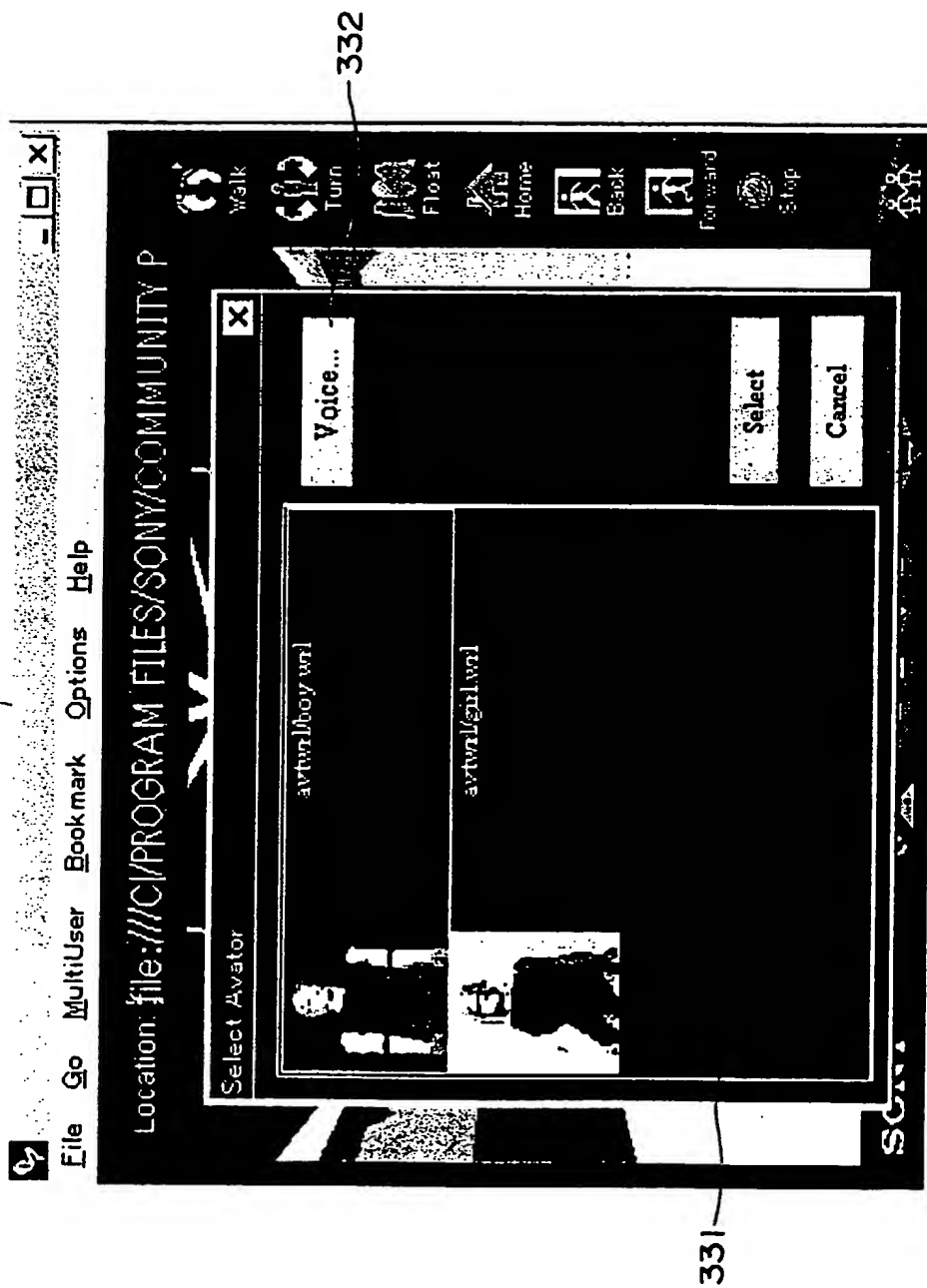


FIG. 43

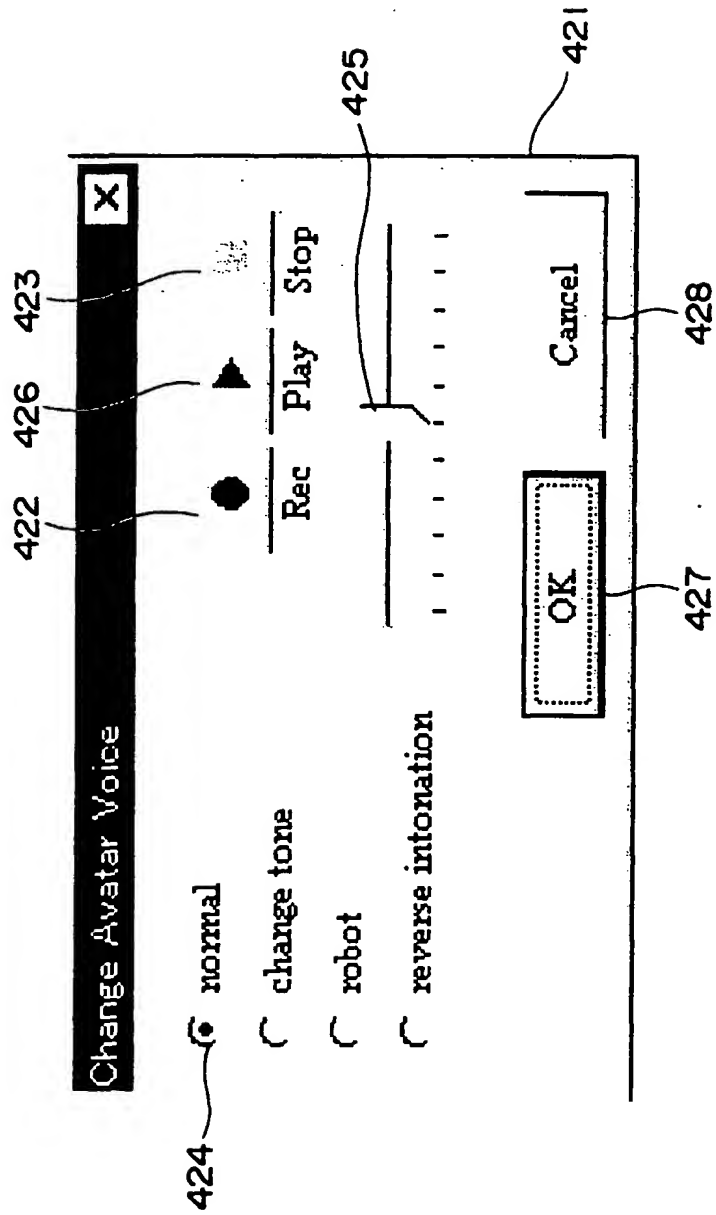


FIG. 44

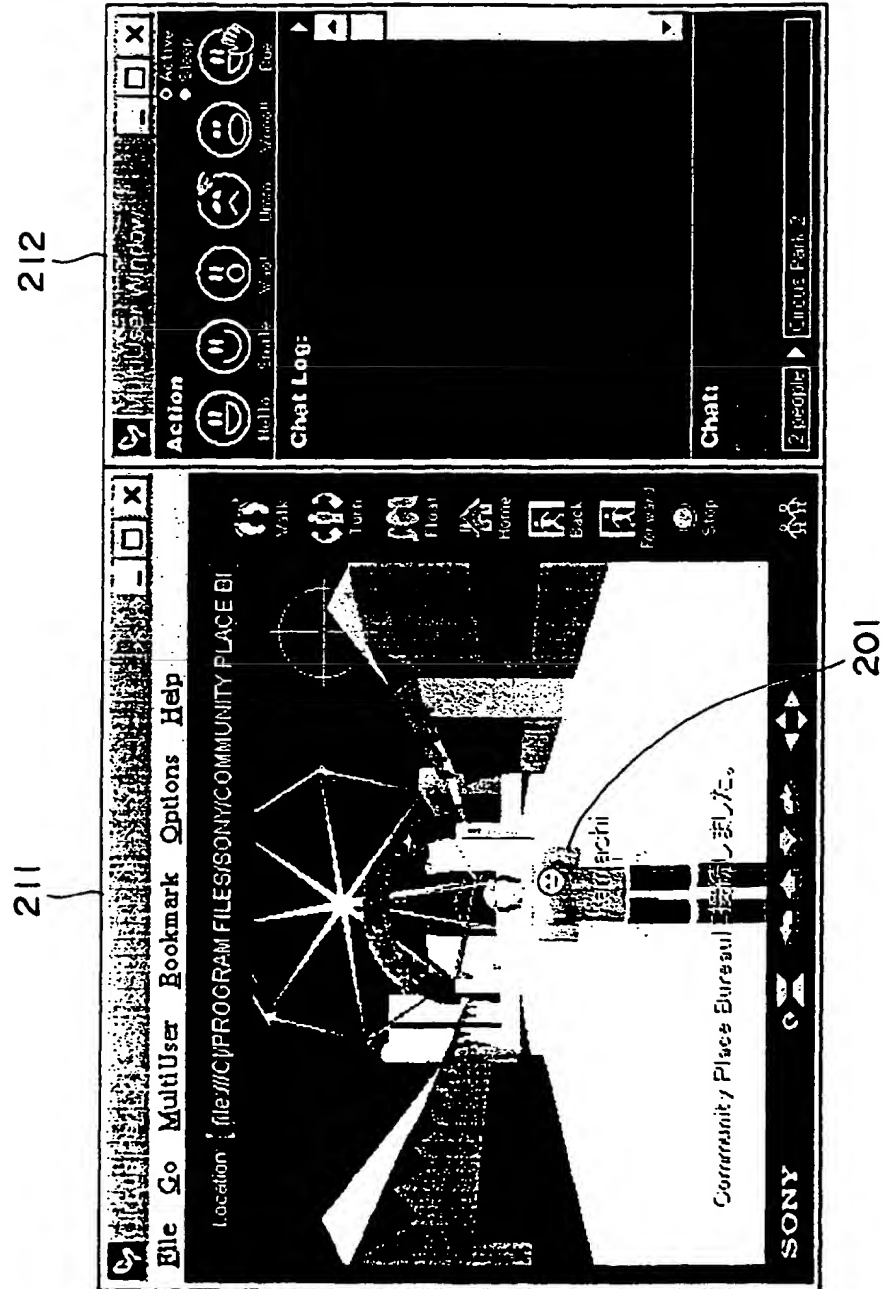


FIG. 45

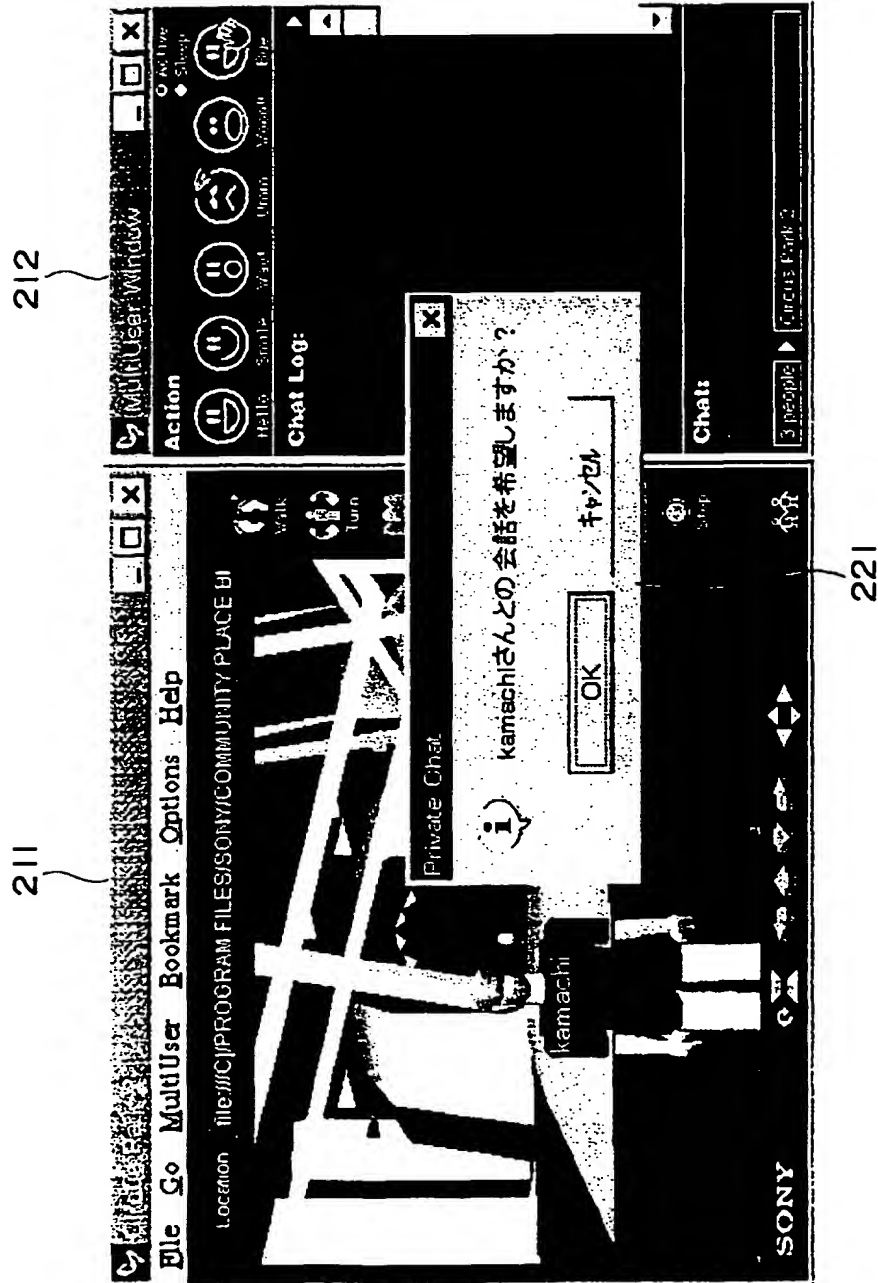


FIG. 46

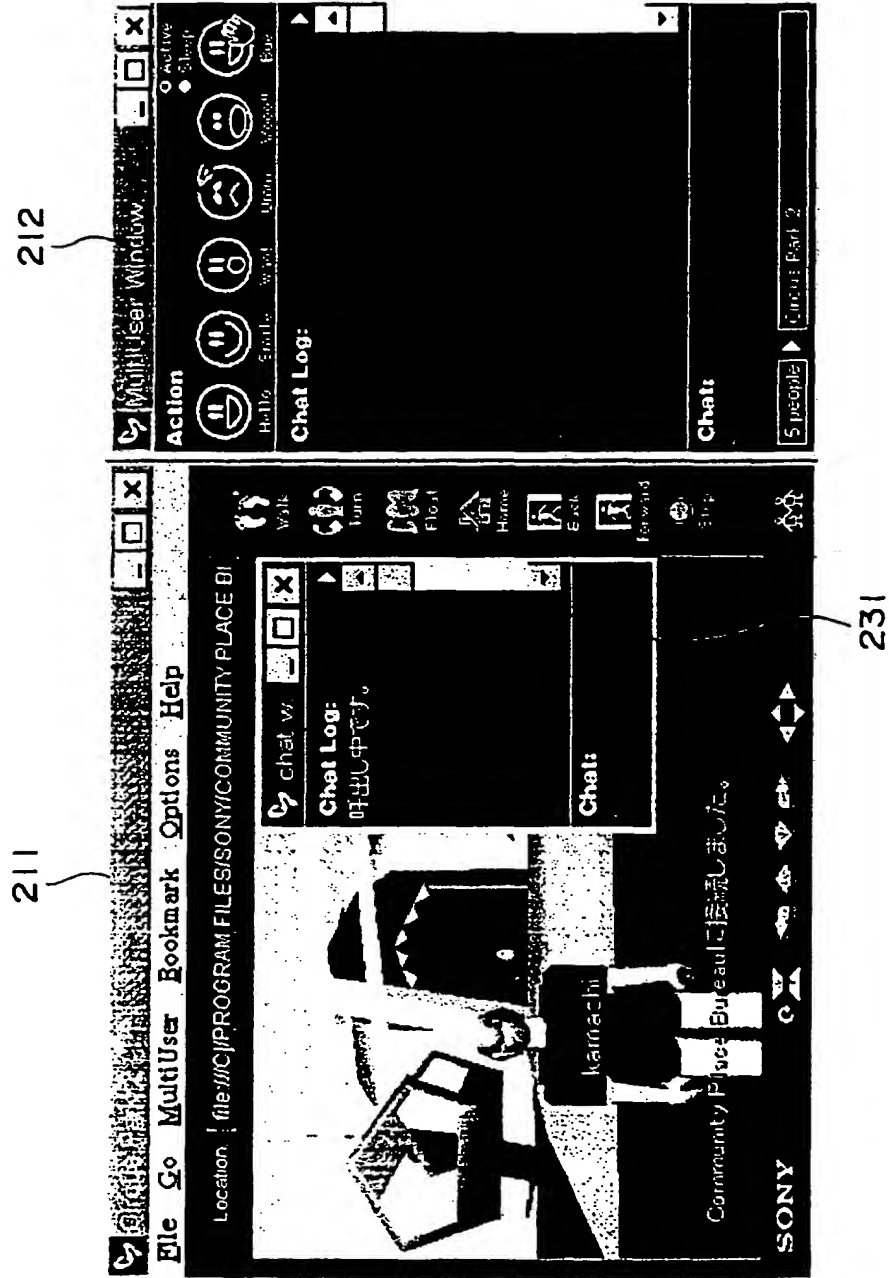


FIG. 47

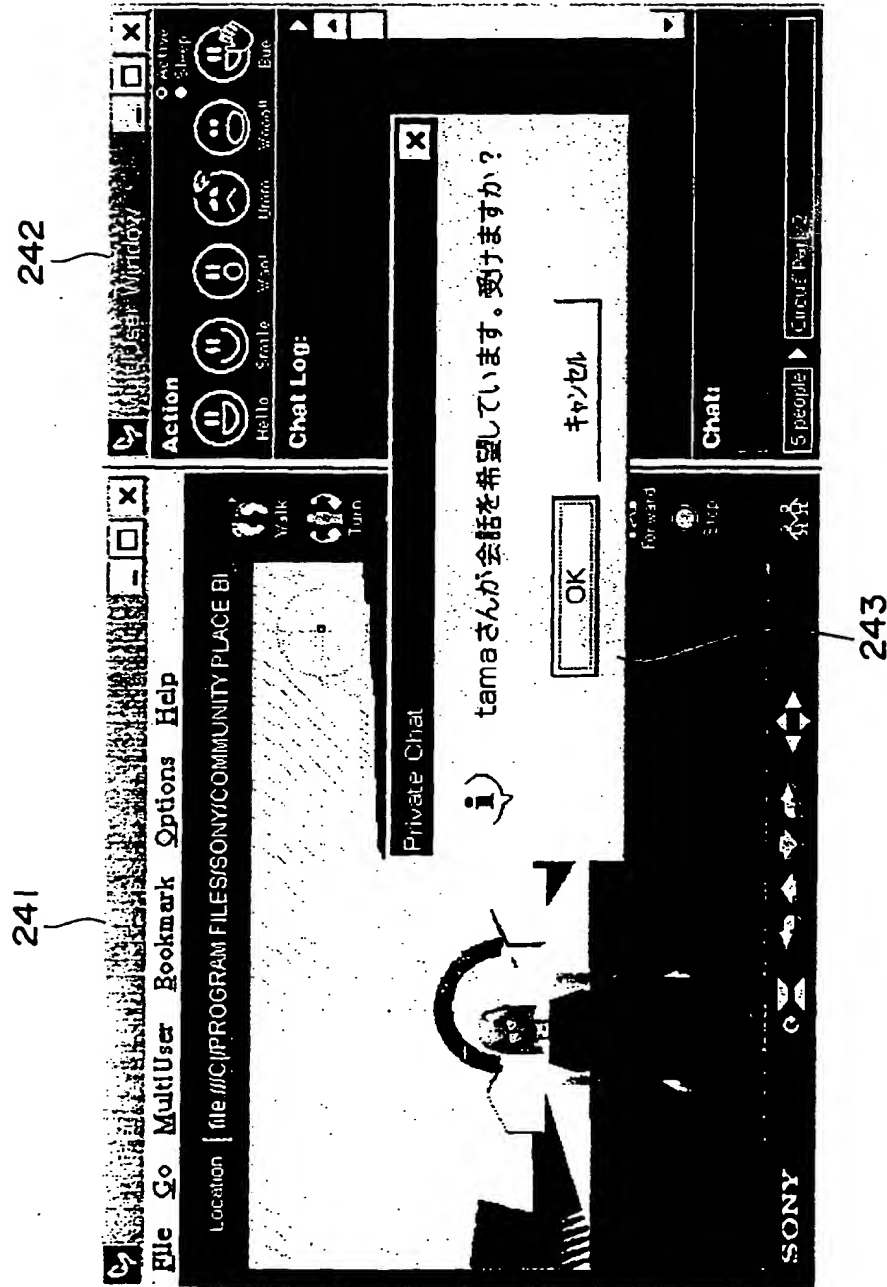
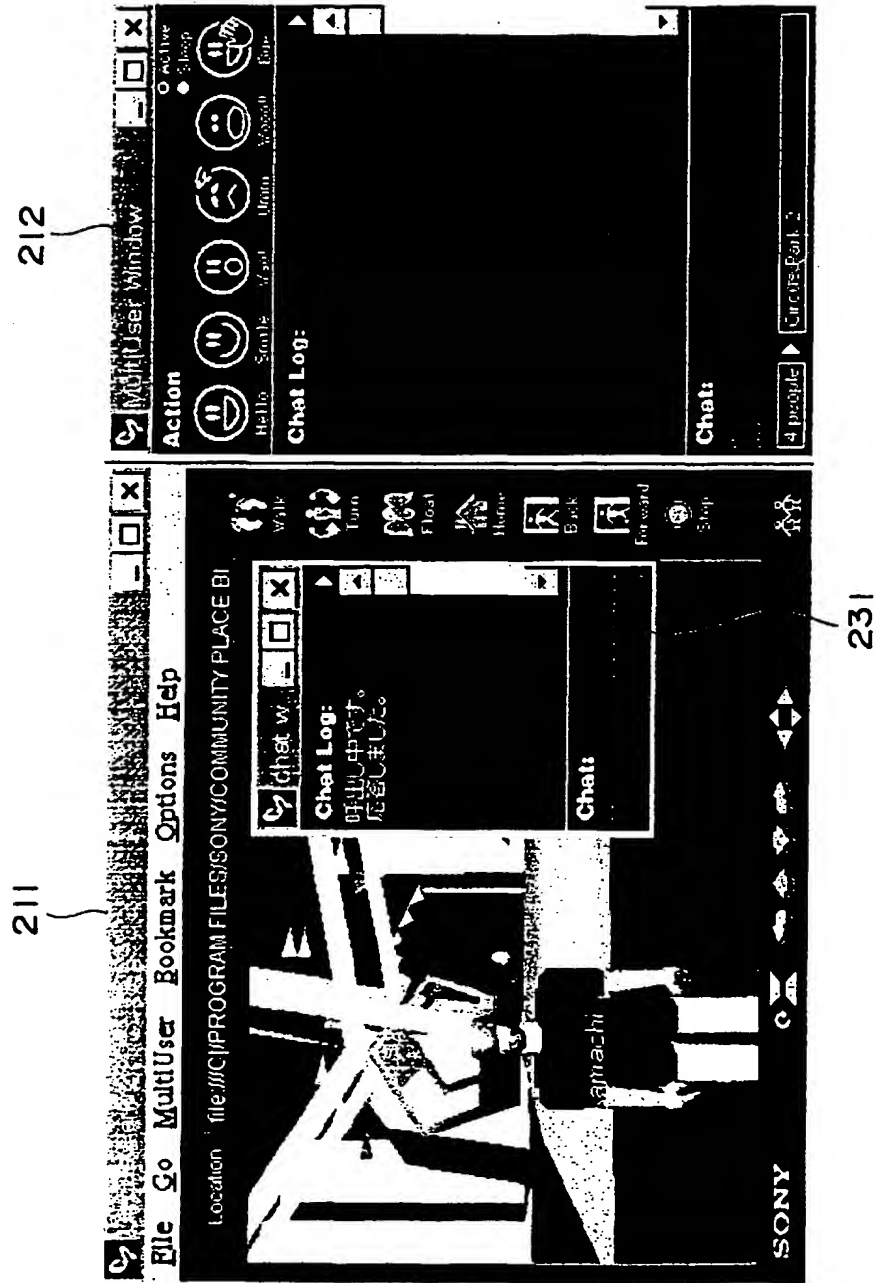


FIG. 48





F-6-49

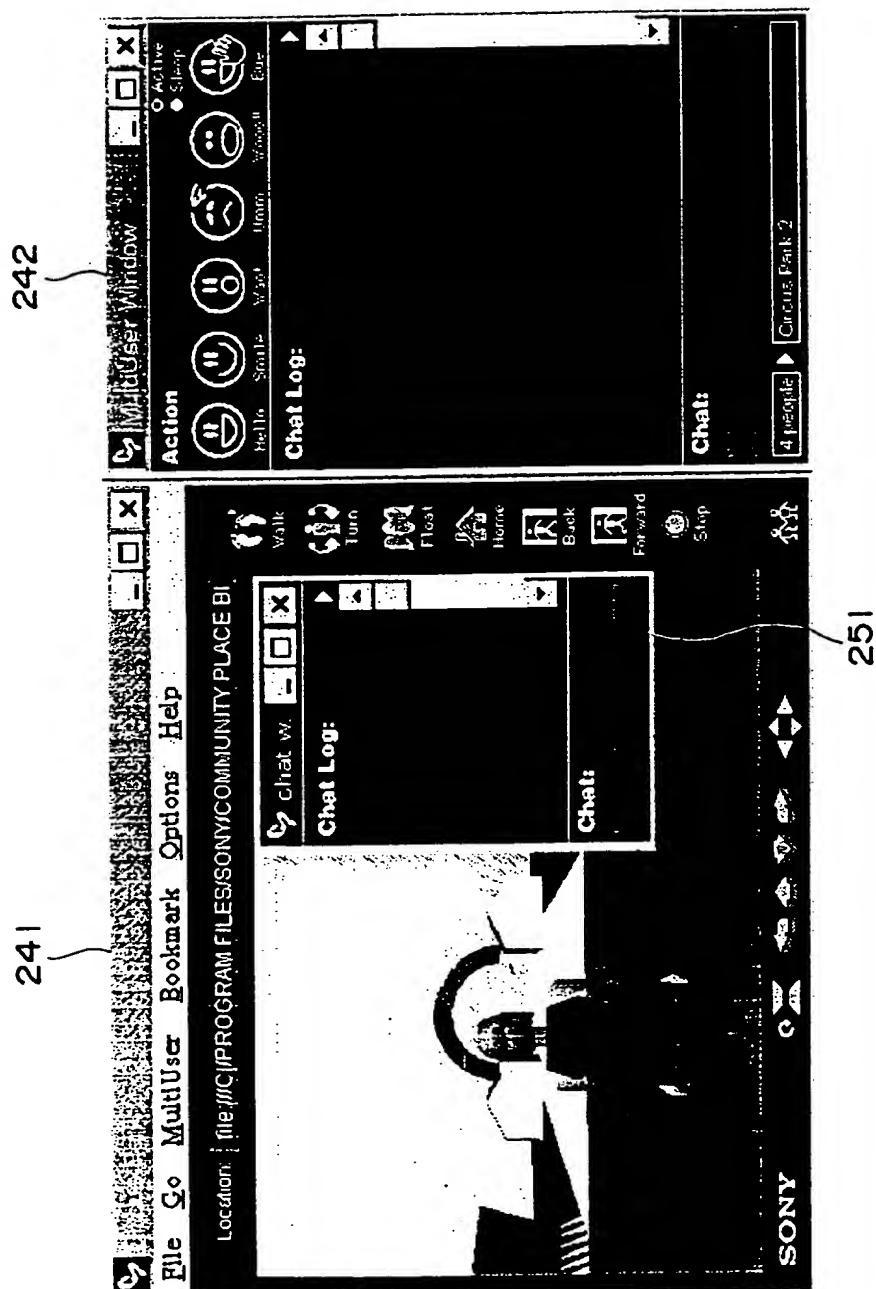
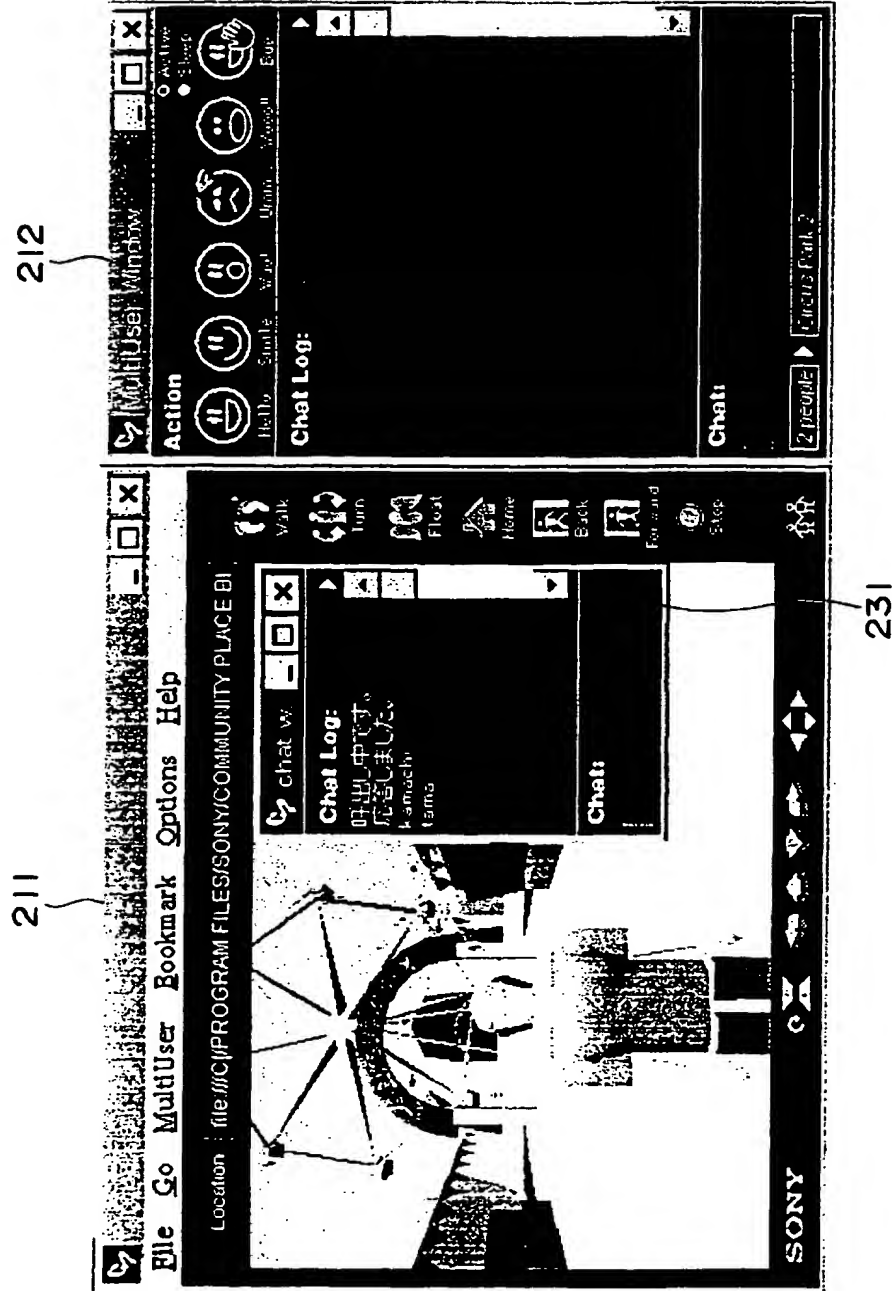


FIG. 50



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